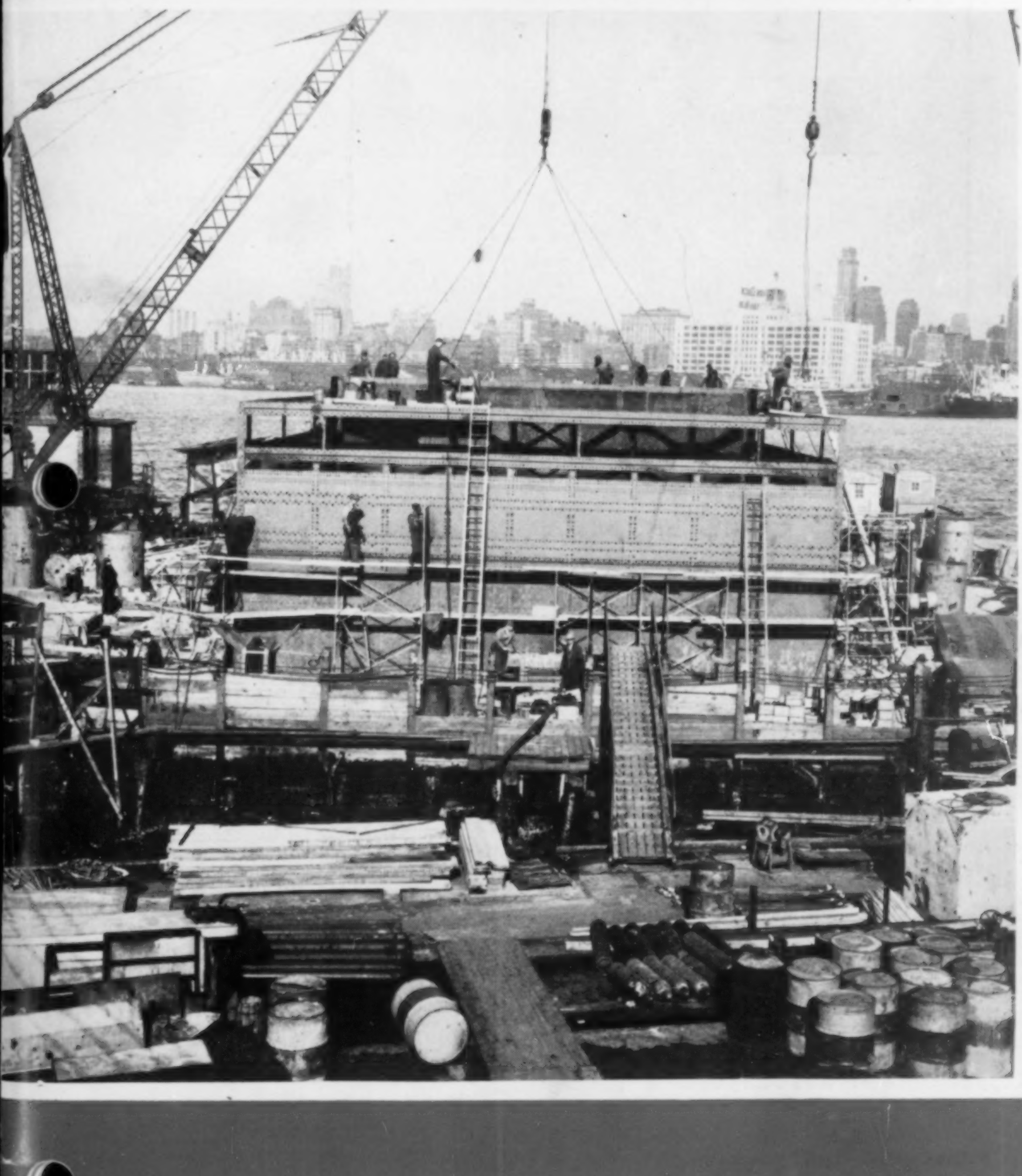
Compressed Air Magazine

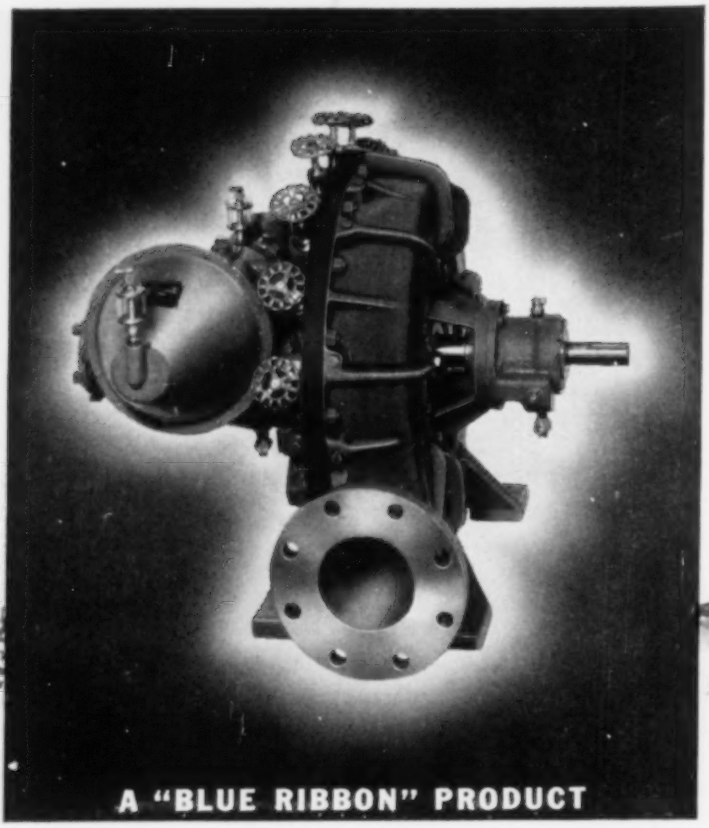
OCTOBER 1947



LARGE CAISSON
FOR AIR SHAFT

Erecting steel structure on which tunnel ventilation building will stand

VOLUME 52 · NUMBER 10 NEW YORK · LONDON



THEY CALL 'EM JEEPS

BECAUSE THEY'RE SMALL, BUT POWERFUL, AND GO ANYWHERE

For a small, tough, hard-working turbine that will go anywhere and do all you expect of it . . . get a Coppus "Blue Ribbon" Steam Turbine.

Coppus Steam Turbines come in six frame sizes from 150 HP down to fractional—so you can match more closely your job requirements. Each smaller size is priced correspondingly less, so by selecting "horsepower" instead of "elephant power" you save on investment and installation cost.

Many well-known manufacturers install Coppus "Blue Ribbon" Steam Turbines on original equipment. They know Coppus quality will protect the reputation of their own products. The Coppus Turbine is also being used on many U. S. Destroyer Escorts, all Casablanca class aircraft carriers and 90% of all Landing Ship Docks.

Like all Coppus "Blue Ribbon" products (blowers, ventilators, gas burners, etc.), the Coppus Steam Turbine is a precision-made product, with accuracy controlled by Johansson size blocks. Every turbine is dynamometer-tested before shipment.

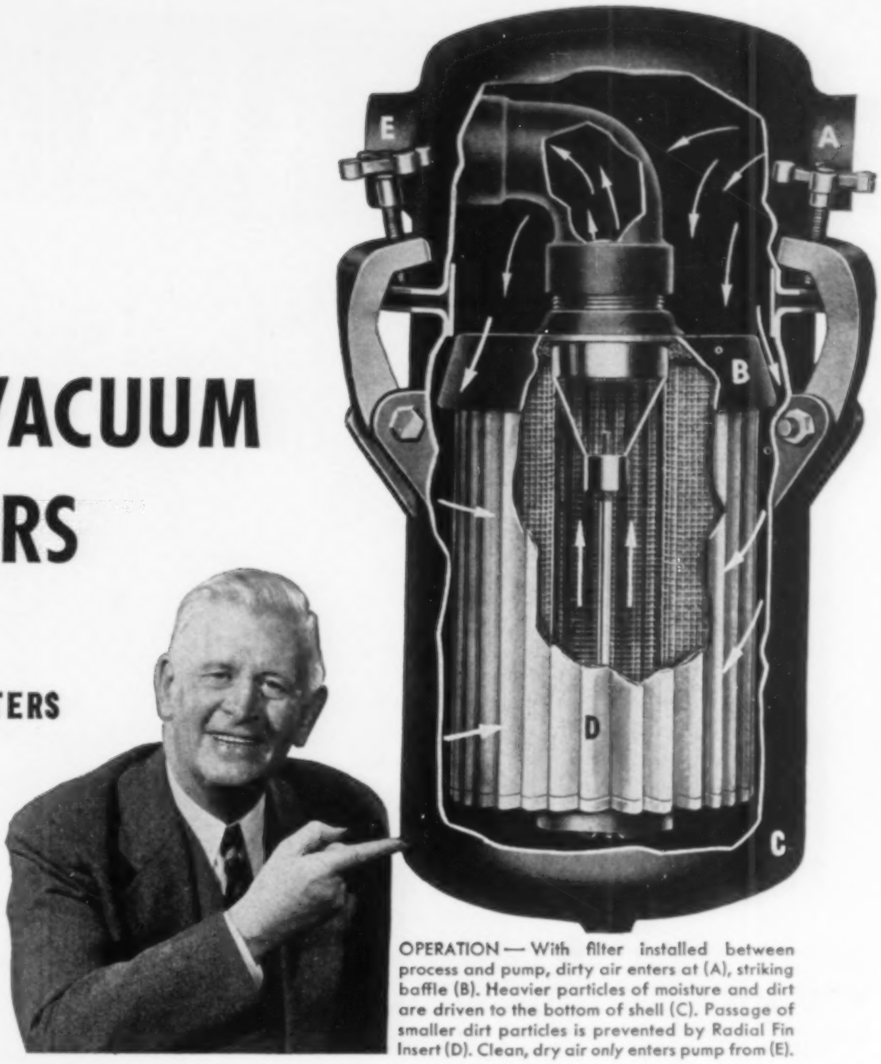
More than 85% of all orders since 1937 have been repeat orders.

ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

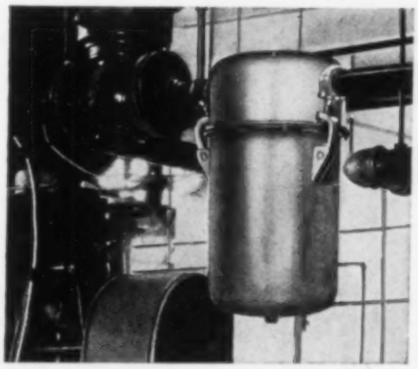
Write for Bulletin 135-9. Coppus Engineering Corporation, 210 Park Avenue, Worcester 2, Mass. Sales offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" Products in SWEET'S, CHEMICAL ENGINEERING CATALOG, REFINERY CATALOG.

ELIMINATE VACUUM PUMP REPAIRS

USE STAYNEW VACUUM FILTERS



OPERATION — With filter installed between process and pump, dirty air enters at (A), striking baffle (B). Heavier particles of moisture and dirt are driven to the bottom of shell (C). Passage of smaller dirt particles is prevented by Radial Fin Insert (D). Clean, dry air *only* enters pump from (E).



A Staynew Vacuum Filter installed by a glass bottle manufacturer saved more than twice its cost every year. As a result, in a recent plant expansion, 10 additional Staynew Filters were placed in service to take advantage of these continuing savings.

COSTLY vacuum pump repairs, caused by intake of abrasive material, are unnecessary. Such repairs can be positively prevented at relatively low cost by the installation of Staynew Vacuum Filters.

Today, hundreds of these filters save time and money in the food, glass, ceramic, steel, chemical and other industries.

Featuring the original Staynew Radial Fin Construction, the high efficiency of Staynew Vacuum Filters makes them ideal for laboratory use.

Models available for both wet and dry process pumps. Special materials can be furnished on request.

COMPLETE INFORMATION ON REQUEST

IN CANADA: McCarthy and Robinson, Toronto Engineering Equipment Co., Montreal

DOLLINGER CORPORATION

FILTERS EXCLUSIVELY SINCE 1921

7 CENTRE PK., ROCHESTER 3, N.Y. • REPRESENTATIVES IN PRINCIPAL CITIES

DOLLINGER
REG.
PROTECTOMOTOR
U.S. PAT. OFF.
STAYNEW FILTERS

NO LEAKS HERE

with the patented . . .

Vogt

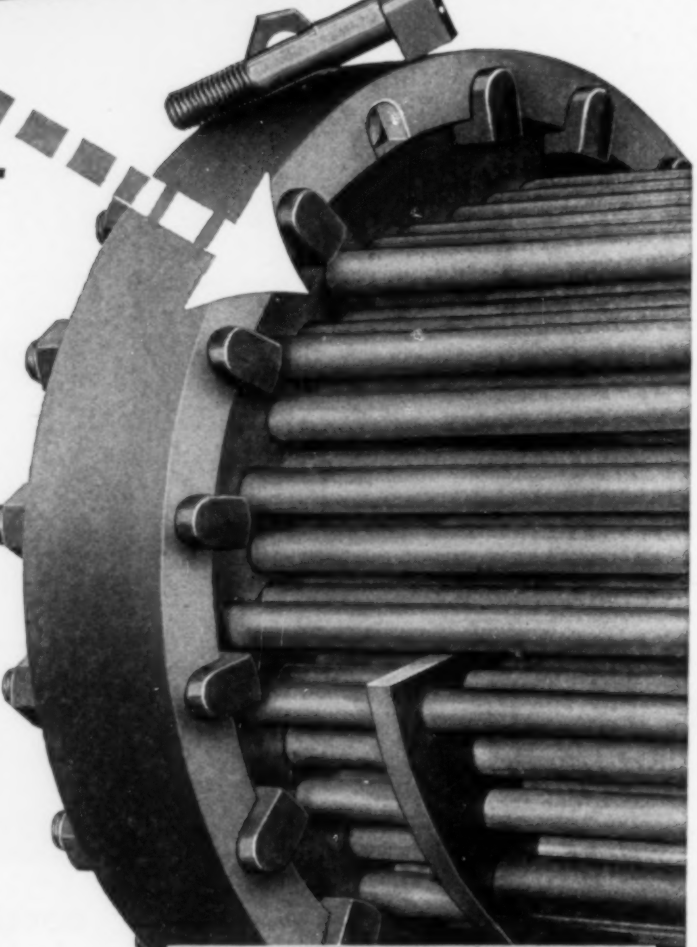
ELL BOLT CONSTRUCTION

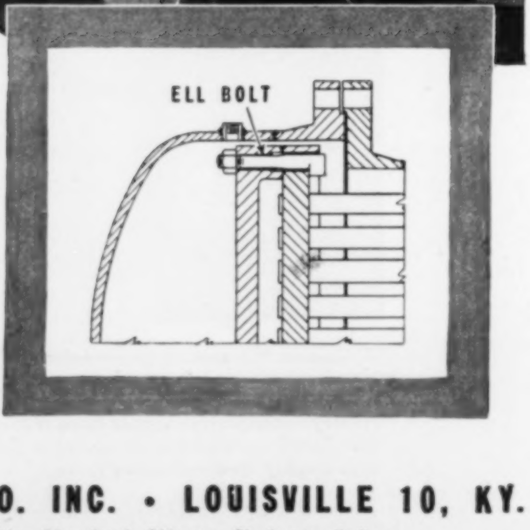
of Floating Tube Sheet Assembly

●

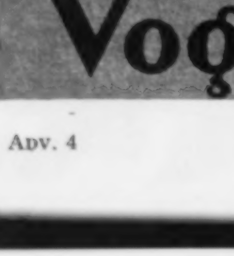
YOU LOSE when an exchanger leaks . . . with the possibility of fluid contamination, or frequent shutdowns for repairs.

None of these evils need plague you when you employ the Vogt patented floating tube sheet assembly because there is no distortion of a split ring to worry about in making up the joint time after time. It's easy to make tight and it stays tight!





Patent Nos.
1,895,735
2,232,478

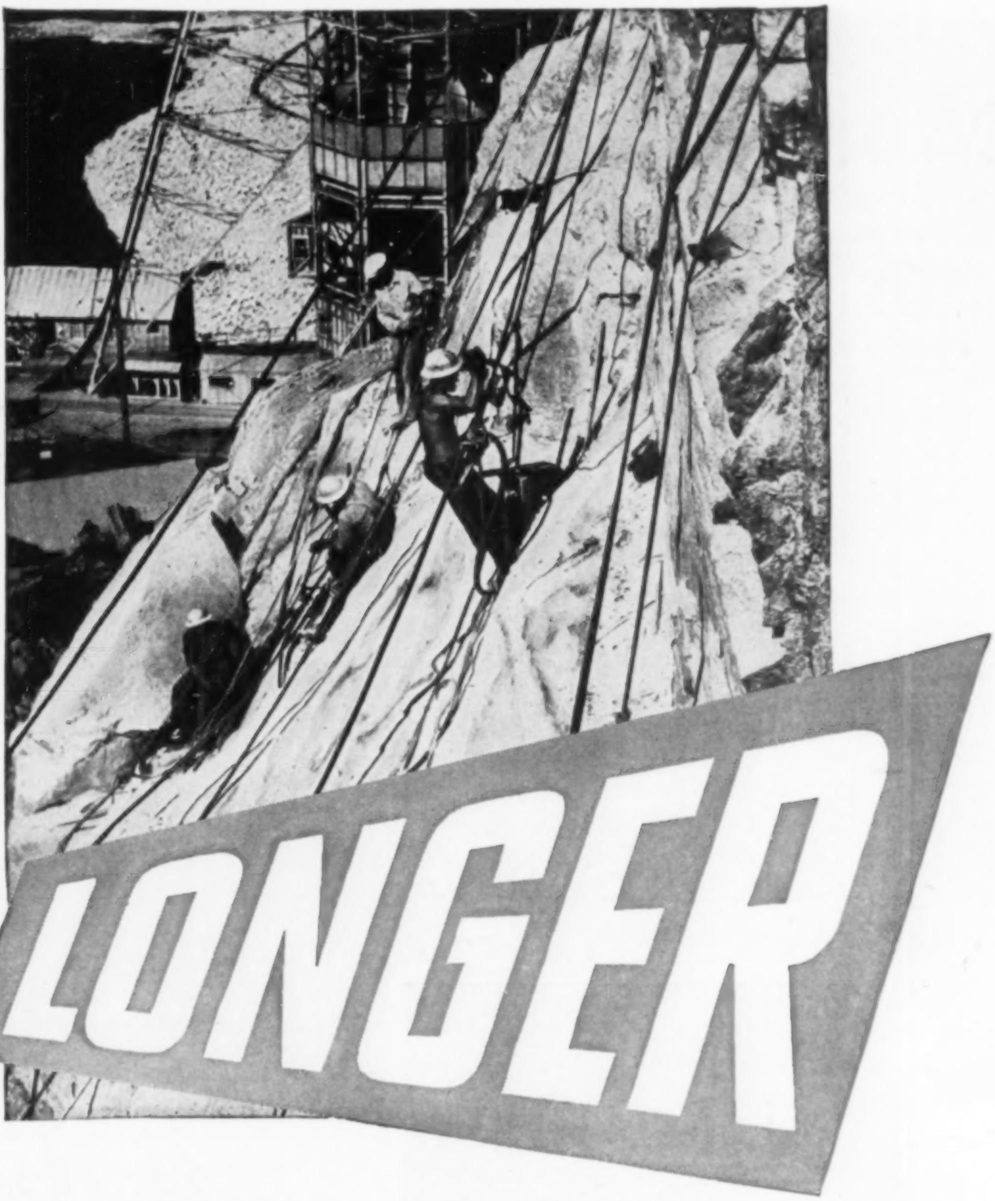


Bulletin HE-5 is a pictorial presentation of standard and special types of Vogt Heat Exchangers. Write for a copy on your letterhead.

HENRY VOGT MACHINE CO. INC. • LOUISVILLE 10, KY.
Branch Offices. New York, Philadelphia, Cleveland, Chicago, St Louis, Dallas

Vogt HEAT TRANSFER EQUIPMENT

KEEP DRILLS ON THE JOB LONGER



WHEN your drills are protected with Texaco Rock Drill Lubricants (E.P.), *they stay on the job longer!* This means fewer delays, lower servicing costs, greater footage per shift from every drill.

Texaco Rock Drill Lubricants (E.P.) are "extreme pressure" lubricants — protect all moving parts with a tough, wear-resistant film that is unaffected by the severest service. They resist oxidation, remain fluid at all temperatures, prevent rust and corrosion in service, standby or storage.

Leading rock drill manufacturers approve Texaco Rock Drill Lubricants (E.P.) for every type of rock drill — every operating condition.

For Texaco Products and Lubrication Engineering Service, call the nearest of the more than 2500 Texaco distributing plants in the 48 States, or write The Texas Company, 135 East 42nd Street, New York 17, New York.

EFFICIENT COMPRESSOR OPERATION

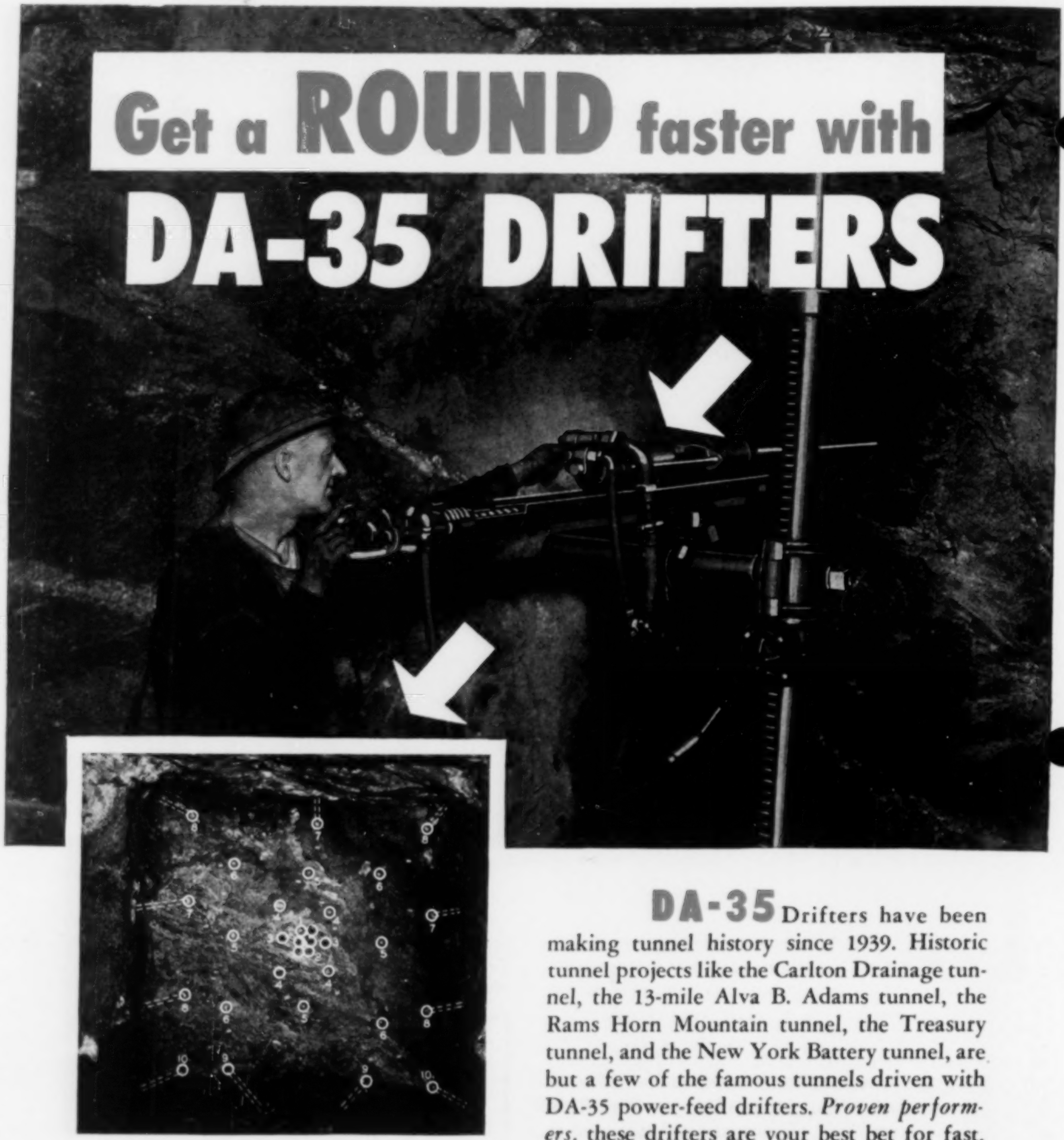
To make your compressors last longer and operate more efficiently, give them effective lubrication — *Texaco Alcaid, Algol or Ursa Oil.* They prevent hard carbon formations — keep rings free, valves active, ports and air lines clear. Let Texaco Lubrication Engineering Service advise which of these famous oils is best for your requirements.

TEXACO REG. T. M.

TEXACO Rock Drill Lubricants (E. P.)

Tune in . . . TEXACO STAR THEATRE presents the TONY MARTIN SHOW every Sunday night. See newspaper for time and station.

Get a ROUND faster with DA-35 DRIFTERS



● Top—Easier work and faster set ups with the DJM Drill Jumbo Mounting.

● Bottom—Typical burn cut Round drilled with DA-35 Drifters.

DA-35 Drifters have been making tunnel history since 1939. Historic tunnel projects like the Carlton Drainage tunnel, the 13-mile Alva B. Adams tunnel, the Rams Horn Mountain tunnel, the Treasury tunnel, and the New York Battery tunnel, are but a few of the famous tunnels driven with DA-35 power-feed drifters. *Proven performers,* these drifters are your best bet for fast, dependable, low-cost drilling. When used with the new I-R Stud Jackbit, these rugged machines will set new highs in tunnel driving. Here are some typical performance figures:

Tunnel Bore	Number of DA-35 Drifters	Tunnel Advance in One Month
Tunnel A—11′ 9″	4	1567 ft.
Tunnel B—12′ 9″ x 12′ 9″	6	1624 ft.
Tunnel C—11′ x 10′	5	1879 ft.

Order dependable DA-35 Power-Feed Drifters for your next job.

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y. 40-5

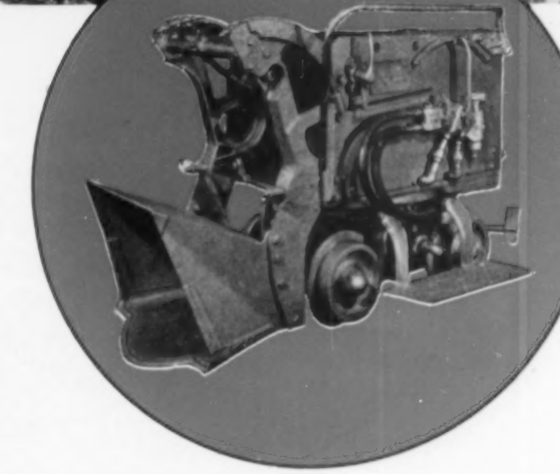
ROCK DRILLS • COMPRESSORS • AIR TOOLS • CENTRIFUGAL PUMPS • TURBO BLOWERS • CONDENSERS OIL AND GAS ENGINES

Good job--
running an Eimco

Times have changed underground. The mucker, who used to have the hardest job, now has the easiest, and that's especially true when he runs an Eimco RockerShovel.

Engineered with special consideration for the man who operates the loader, all Eimco RockerShovels have the controls mounted within natural, easy reach of the operator. The swing has been designed so that it is easy and stays easy. Many safety features are included in the design for the benefit of the man doing the job.

Yes! The mucker these days really has a good job. Write for more information on the RockerShovel.



Only Eimcos incorporate all the advantages of speed, power and economy with 15 different safety features for protection of the operator, multi-step digging width stops, leak-proof valves, anti-friction bearings throughout and heat-treated alloy-steel castings for heavy-duty 24 hour operation.

EIMCO

THE EIMCO CORPORATION

The World's Largest Manufacturer of
Underground Rock Loading Machines

Executive Offices and Factories — Salt Lake City 8, Utah:
Branches — 67 Wall St., New York 5 — 3319 So. Wallace, St.,
Chicago 16—Mills Bldg., El Paso—1217 - 7th St., Sacramento 14

A147

for Power or Process piping . . .
everything's in the CRANE line

ONE
SOURCE OF SUPPLY
RESPONSIBILITY
STANDARD OF QUALITY

Valves, fittings, or pipe line accessories . . . pipe or shop-fabricated piping units . . . whatever you need for new installations or replacements . . . most likely Crane supplies it. And with good, dependable quality in every single item.

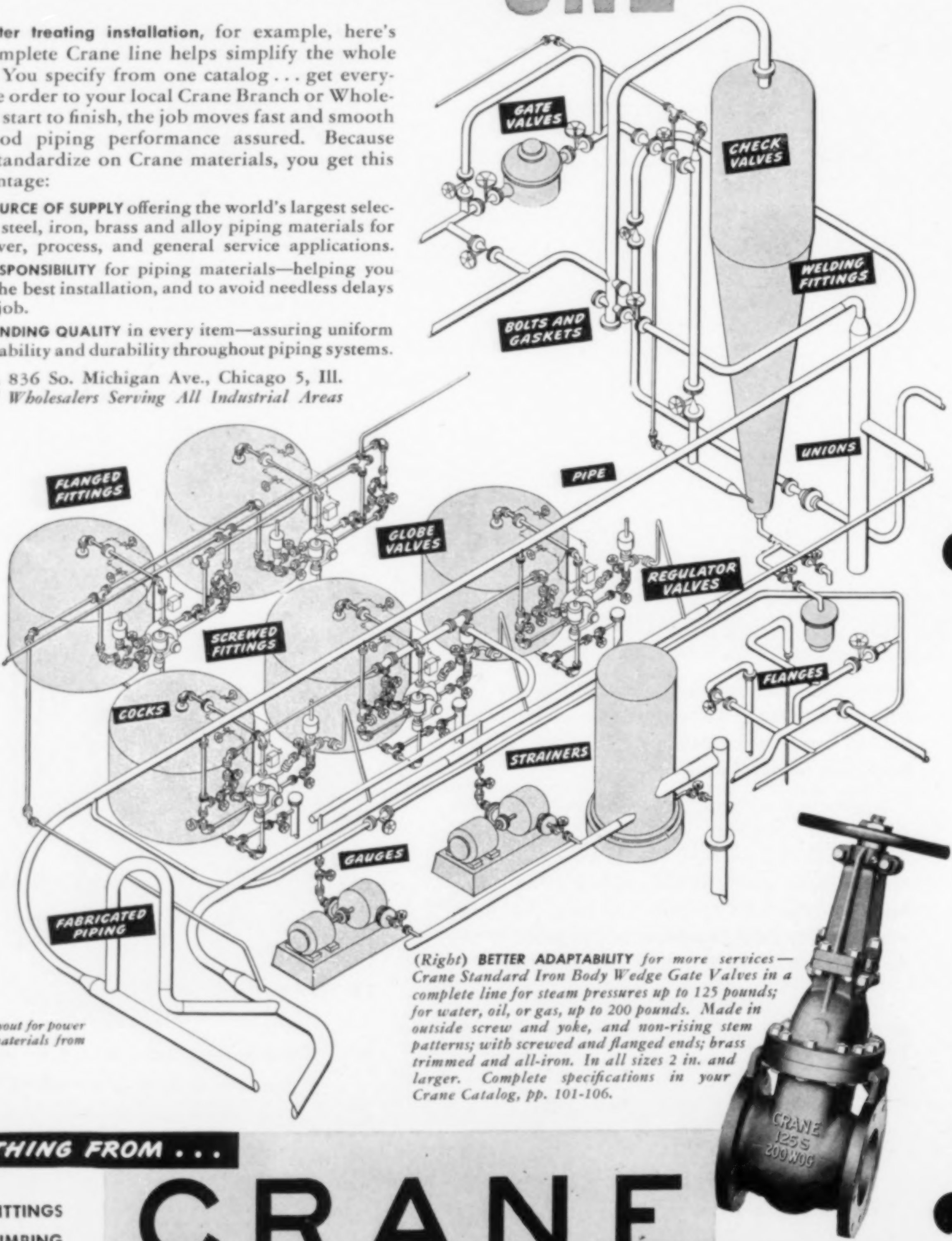
On this water treating installation, for example, here's how the complete Crane line helps simplify the whole piping job. You specify from one catalog . . . get everything on one order to your local Crane Branch or Wholesaler. From start to finish, the job moves fast and smooth . . . with good piping performance assured. Because when you standardize on Crane materials, you get this 3-way advantage:

ONE SOURCE OF SUPPLY offering the world's largest selection of steel, iron, brass and alloy piping materials for all power, process, and general service applications.

ONE RESPONSIBILITY for piping materials—helping you to get the best installation, and to avoid needless delays on the job.

OUTSTANDING QUALITY in every item—assuring uniform dependability and durability throughout piping systems.

CRANE CO., 836 So. Michigan Ave., Chicago 5, Ill.
Branches and Wholesalers Serving All Industrial Areas


GATE VALVES
CHECK VALVES
WELDING FITTINGS
BOLTS AND GASKETS
UNIONS
PIPE
FLANGED FITTINGS
GLOBE VALVES
REGULATOR VALVES
SCREWED FITTINGS
FLANGES
COCKS
STRAINERS
GAUGES
FABRICATED PIPING

Water treating layout for power plant . . . piping materials from Crane.

CRANE
125 S
200 WOG

(Right) **BETTER ADAPTABILITY** *for more services—Crane Standard Iron Body Wedge Gate Valves in a complete line for steam pressures up to 125 pounds; for water, oil, or gas, up to 200 pounds. Made in outside screw and yoke, and non-rising stem patterns; with screwed and flanged ends; brass trimmed and all-iron. In all sizes 2 in. and larger. Complete specifications in your Crane Catalog, pp. 101-106.*

EVERYTHING FROM . . .

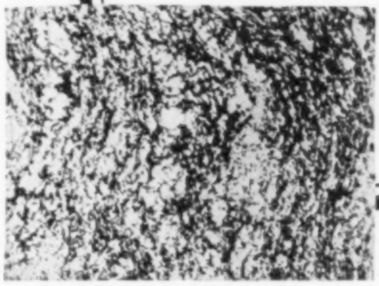
CRANE

FOR EVERY PIPING SYSTEM

VALVES • FITTINGS
PIPE • PLUMBING
AND HEATING

NEW AIR LINE FILTER

GIVES SURER, LONGER PROTECTION AGAINST MOISTURE


Magnified Section of Filter Element

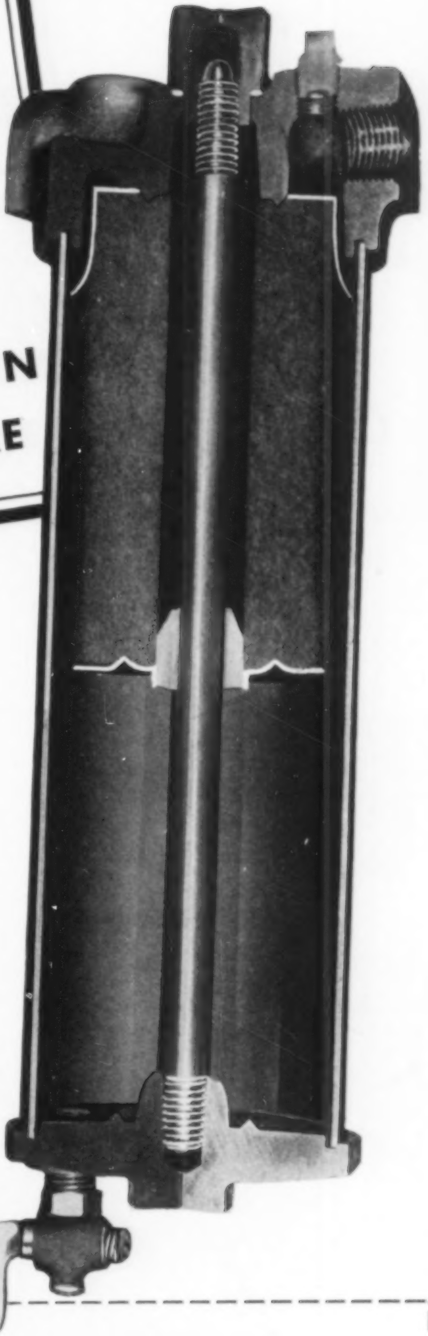
More positive removal of moisture results from a special baffling arrangement plus a newly-developed method of "felting" and impregnating micronic fibres. Moisture not deflected by the baffle is required to make hundreds of sharp turns through the minute interstices, impinging on the hydrophobic fibre structure, then draining freely to the collecting chamber. Channeling is positively prevented by the resinous impregnation.

Longer replacement-free service results from non-wicking property of the fibres. Accumulated moisture drains readily into extra-large collection chamber below filtering cartridge. Simple, sturdy housing is quickly disassembled for cartridge replacement by removing single cap nut.

MICRO-KLEAN Compressed Air Filter models now available handle up to 40 cfm of free air at pressures up to 125 psi. Larger capacity units in preparation.

Cuno MICRO-KLEAN Compressed Air Line Filters and replaceable cartridges are manufactured by the company whose filters are used more often in industry than any other brand.

Because it extracts the maximum amount of entrained moisture and dirt without requiring frequent cartridge replacement . . . the new Cuno MICRO-KLEAN is ideal for filtering compressed air under severe moisture conditions.



CUNO

Fluid Conditioning

REMOVES MORE SIZES OF SOLIDS FROM MORE TYPES OF FLUIDS

AUTO-KLEAN
General service down to .0035" Disc-type. Continuously cleanable.

FLO-KLEAN
For highly abrasive solids down to .0025". Wire-wound. Continuously cleanable.

MICRO-KLEAN
Micronic-type. Impregnated fibre. "Graded Density in Depth" cuts replacement cost.

COOLANT-KLEAN
Low-cost unit filtration of grinder coolant. Fabric-type element.

SEND COUPON FOR FREE FACTS TO FIT YOUR INSTALLATION

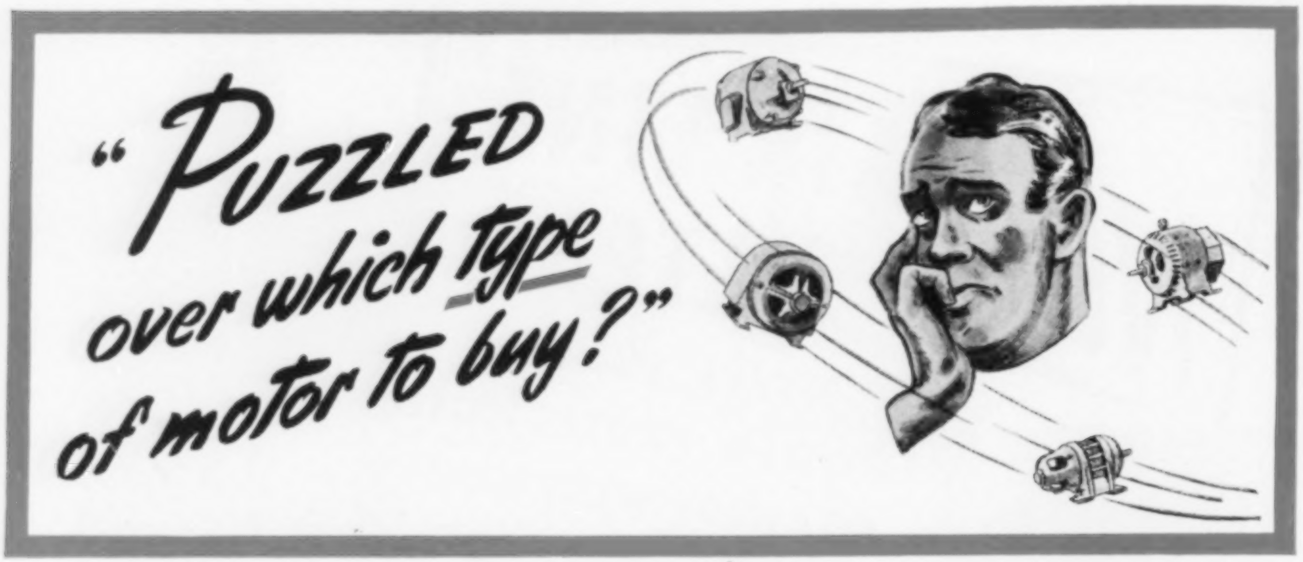
CUNO ENGINEERING CORPORATION
1710 South Vine Street,
Meriden, Conn.

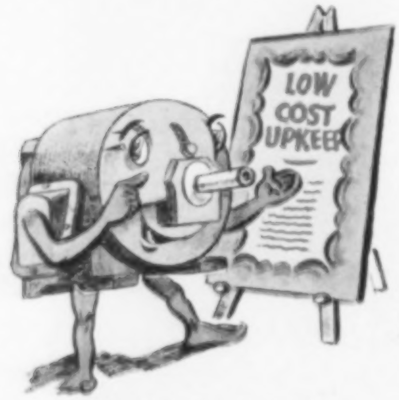
Please have nearest Cuno representative provide information on Cuno Model 1B1G Compressed Air Filter.

Name................................Title ....

Company..

Address..


"Puzzled over which type of motor to buy?"



In 80% of the Cases, open squirrel-cage induction motors meet the need. They fit most drives, and can be obtained in numerous standard and special designs to meet varying conditions of starting torque, slip, etc. They are also the most economical type to buy and to maintain. Allis-Chalmers builds induction motors in sizes from ½ to 10,000 hp — or higher, if needed.

For Tough Starting Conditions, wound-rotor induction motors are recommended. Their high starting torque, at comparatively low starting current, and their controllable speed characteristics are desirable in drives for conveyors, grinding mills and other tough starting assignments. Compact, accessible Allis-Chalmers wound rotor induction motors range in size from 5 to 10,000 hp.

For Slow Speed, direct-connected drives as low as 75 rpm, or other constant speed applications at higher rpm, synchronous motors are a good solution. They are of particular benefit when a system's power factor is low, since they can be furnished for operation at either unity or leading power factor. From 40 hp to 50,000 hp and higher — in bracket bearing, pedestal bearing, or engine types.

D-C CURRENT ONLY

Is d-c Available? Then adjustable speed operation is easily obtainable. Allis-Chalmers builds d-c motors from ½ to 10,000 hp and higher — for constant or adjustable speed duty in ranges of 6:1 and lower. By means of a source of d-c voltage, adjustable speed motors may also be designed to operate over a speed range as high as 30:1. Suitable for fans, elevators, etc.

Select from the Complete Allis-Chalmers Line!

NOT JUST FOLLOWING popular choice and using a standard squirrel cage induction motor. But the *right* motor for economy and efficiency.

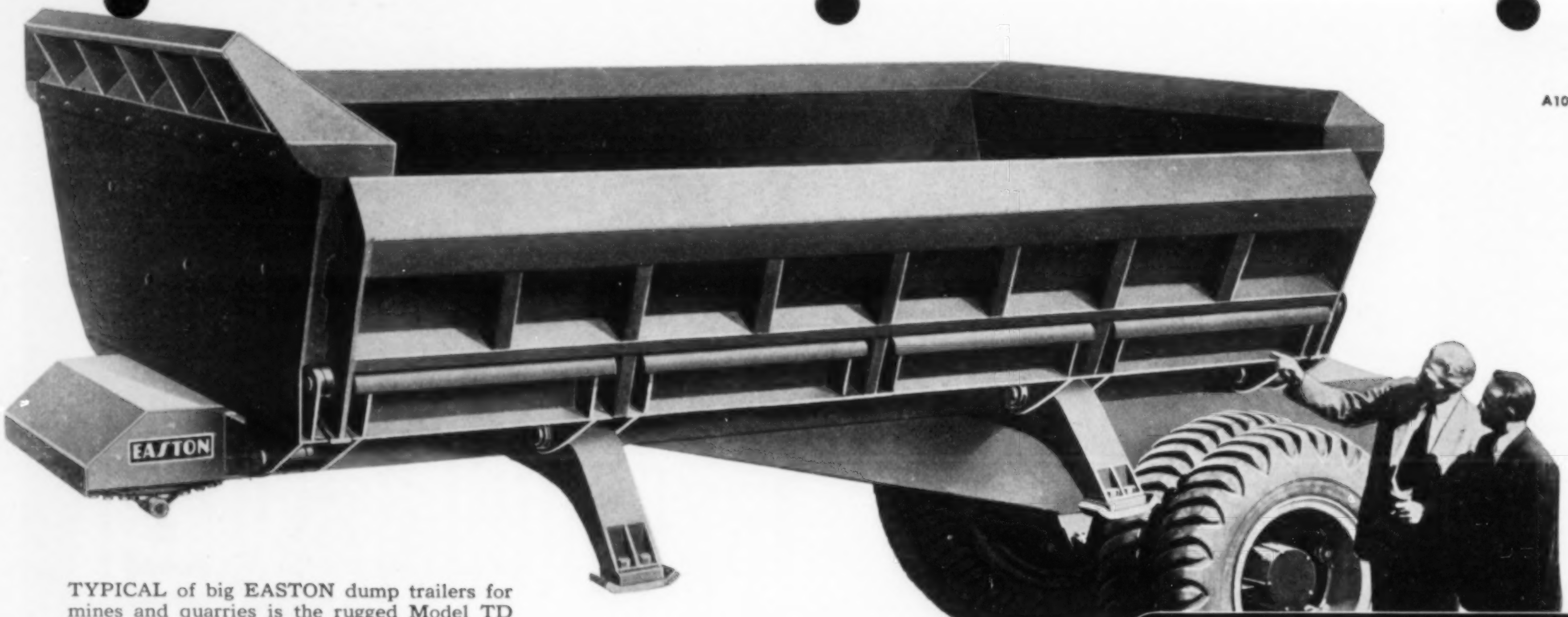
That means an overall knowledge of *all* types of motors . . . their operation . . . limitations . . . maintenance. And there's where your A-C representative can be a big help. His recommendations are backed by experience . . . and the Allis-Chalmers motor he selects is *itself* backed by 50 years of experience in motor design and building. ALLIS-CHALMERS, MILWAUKEE 1, WIS. A 2304

ALLIS-CHALMERS

1847 AC 1947
A CENTURY OF SERVICE
to Industry
THAT MADE
America Great

One of the Big 3 in Electric Power Equipment-
Biggest of All in Range of Industrial Products

A1012



TYPICAL of big EASTON dump trailers for mines and quarries is the rugged Model TD which features an automatic down-folding side door. Capacities up to 40 tons.

EASTON Trailers

TO MOVE BIG LOADS AT LOW COST . . .

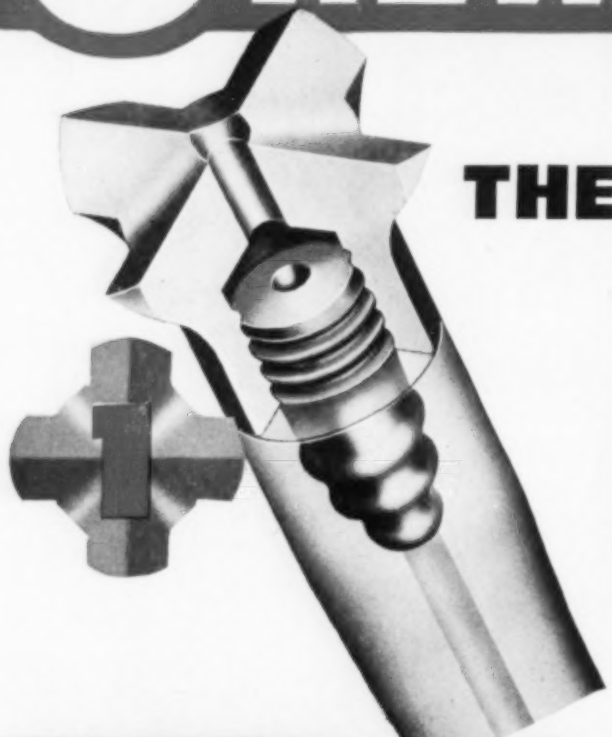
PORTABILITY is the advantage featured in this specially designed EASTON trailer, which mounts a 1500 gallon chemical storage tank.

Speed, flexibility, lower costs, and the ability to move bigger loads with less power—these are some of the advantages which have helped to introduce the trailer idea to mines, quarries, industrial plants and other off-highway haulage operations. Application of the proved advantages of big, pneumatic-tired trailers to new fields of off-highway service has followed the initiative of foresighted plant operating executives. Men who want to move bigger loads at lower cost will envision new opportunities to save with big, off-highway trailers. Easton will design and build these trailers.

Easton Car & Construction Company, Easton, Pa.

ALL TYPES OF HEAVY-DUTY INDUSTRIAL CARS • TRAILERS • TRUCK BODIES • ELECTRIC TRUCKS

3 NEW Detachable
A Triple Threat



THE JACKSTUD
A Better Attachment

Here is the Jackstud, an Ingersoll-Rand development for attaching Jackbits, that results in increased drilling speed, ease of detachability, and longer rod life. The Jackstud design permits the use of the best possible alloy material for the attachment thereby providing strength and durability unobtainable in a one-piece drill rod. The Jackstud produces a thread attachment in the field with factory accuracy. There is no need for special machine shop equipment. The Jackstud is driven cold into the hot drill steel by the machine that is most natural to mine shop men—the Ingersoll-Rand Sharpener. Only the usual simple heat treatment is required to put it in condition for service.

Check these distinctive advantages:

Uniform, factory-perfect threads, always available on the job. No special machine shop equipment is required.

Continued easier detachability because these case-hardened threads retain their shape and resist wear.

Bits cannot lock on. The full Jackstud thread prevents the bit skirt from mushrooming.

Longer rod life results from the combination of an extremely strong, durable stud and an exceptionally large driving shoulder.

Especially adapted to small bits, with their inherent advantages, because the Jackstud attachment permits stronger construction in small bits and attachments.

Excellent performance with any commercial drill steel whether of the carbon or alloy type.

Wherever the Jackstud is being used, drilling speed and rod life are greatly increased and bits are more easily removed.

← *The patented method of driving the Jackstud is easy with the I-R Sharpener.*

Ingersoll-Rand

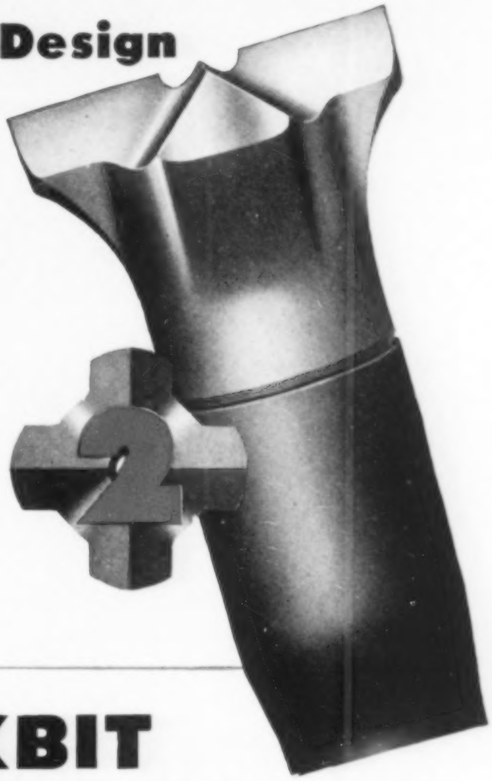
11 BROADWAY, NEW YORK 4, N. Y.

39-15

AIR TOOLS • COMPRESSORS • ROCK DRILLS • TURBO BLOWERS •

Bit Developments
to Your Tough Drilling Problems . . .

STUD JACKBIT New Design



The Stud Jackbit, a twin development with the Jackstud, was designed to fill a long felt need for a better steel bit. It drills faster, is easier to detach, and has a minimum of gage loss. The advanced design of the Stud Jackbit and rod has enabled us to place more metal in the bit, particularly at the points where it is most needed, resulting in a bit that is thick bodied and heavier throughout. This added strength permits stronger construction in small bit sizes. The higher drilling speeds obtained, size for size, with this new bit and still faster speeds obtained through the use of smaller bits, means a saving of many dollars. In addition, with the Stud Jackbit, you can

- Drill faster because of increased bearing area between the bit and rod and other advanced design features;
- Detach bits easier because of the improved buttress thread design and strong construction which resists upsetting;
- Have less gage wear because of properly proportioned wing width, gage angle, and gage length.
- Maintain new bit proportions on reconditioning because of a special curved wing design;
- Retain good bit threads because the Stud Jackbit is used with the hardened Jackstud.

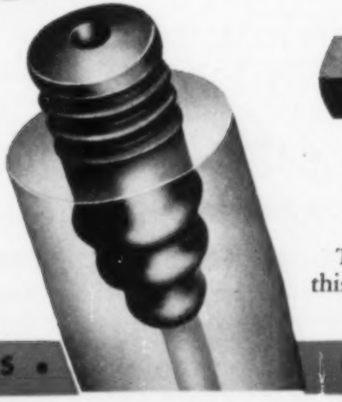
THE CARSET JACKBIT
Revolutionary Performance

The Carset Jackbit is a revolutionary, new Jackbit set with cutting edges of tungsten-carbide, the hardest known metallic substance. We believe this new bit is the answer to many drilling problems. It is the fastest drilling and longest wearing rock drill bit we have ever developed.

The Carset Jackbit has all of the features of the stud Jackbit plus the advantage of a supercutting edge. It is interchangeable with the stud Jackbit.

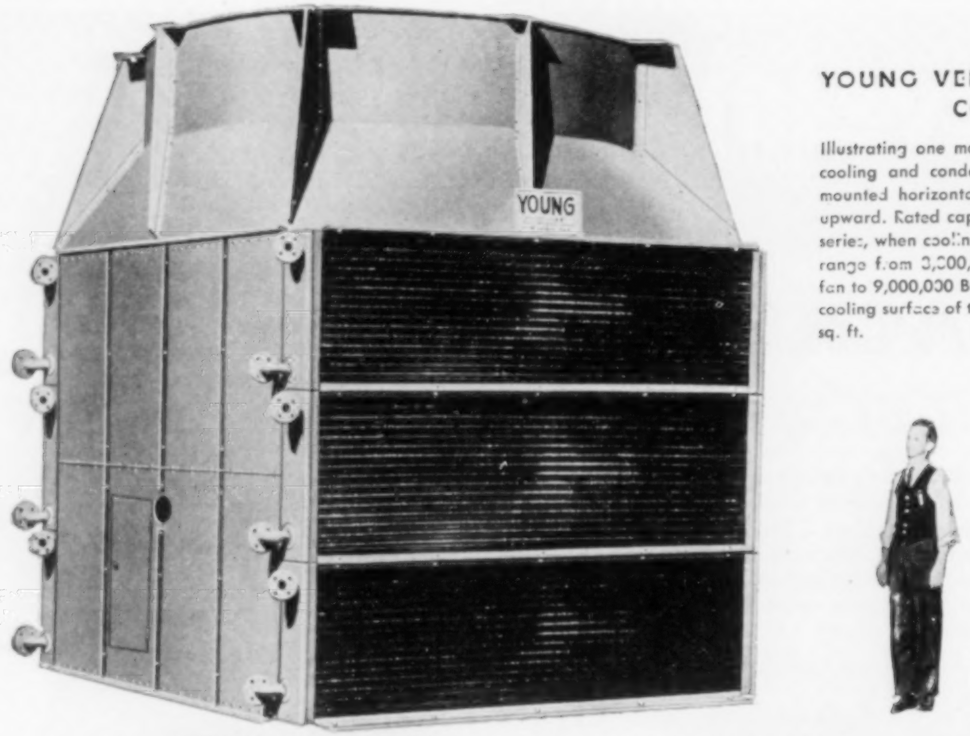
Think what these advantages mean:

- Drill continuously with one size bit.
- Use steels as long as setup permits.
- Small, uniform diameter holes.
- Maintained high drilling speed.
- Negligible gage wear .
- Changing of bits practically eliminated.
- Adaptability to all rock drills.
- Bit reconditioning reduced or eliminated.
- Use less explosives.
- Drill the hardest rock.
- Finish more rounds per week.



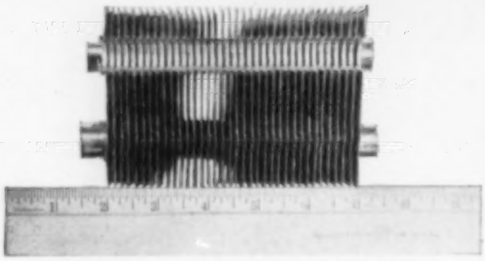
Try Carset bits on your property and determine the economics of this remarkable Jackbit.

CONDENSERS • CENTRIFUGAL PUMPS • OIL & GAS ENGINES



YOUNG VERTICAL AIR DISCHARGE COOLING UNIT

Illustrating one model in a new series of large capacity cooling and condensing radiators. Induced-draft fan is mounted horizontally in the shroud with air discharged upward. Rated capacities of the various sizes in the VAD series, when cooling from 150°F. to 140°F. with 100° air, range from 3,000,000 Btu/hr. using 25 H.P. for cooling fan to 9,000,000 Btu/hr. with 50 H.P. fan. Total air swept cooling surface of the largest unit is approximately 42,000 sq. ft.



Section of core used in the above cooling unit. Continuous-type fins are formed from copper strip.

12,800 FEET OF SEAMLESS COPPER TUBE

FOR EFFICIENT COOLING OF WATER, OIL OR GAS

NEARLY 2½ miles of Anaconda Seamless Copper Tube go into the giant Vertical Air Discharge Cooling Unit manufactured by Young Radiator Company, Racine, Wisconsin. Tubes are ⅝" O.D. x .035" wall thickness.

The uniformly high quality of Anaconda Deoxidized Copper Tubes is an important factor in the construction of very large heat exchange equipment. For units like this, down to small space heaters and automobile radiators, manufacturers select copper for its high thermal conductivity, corrosion resistance, durability and ease of working. Where unusual corrosion resistance or extra strength is required, The American Brass Company offers a wide choice of the highest quality corrosion-resistant metals in the form of sheets, rods and tubes for heat exchange equipment.

Call on our Technical Department for assistance in selecting the most suitable alloys for your requirements.

4779

ANACONDA
from mine to consumer

Anaconda

COPPER & COPPER ALLOYS

THE AMERICAN BRASS COMPANY

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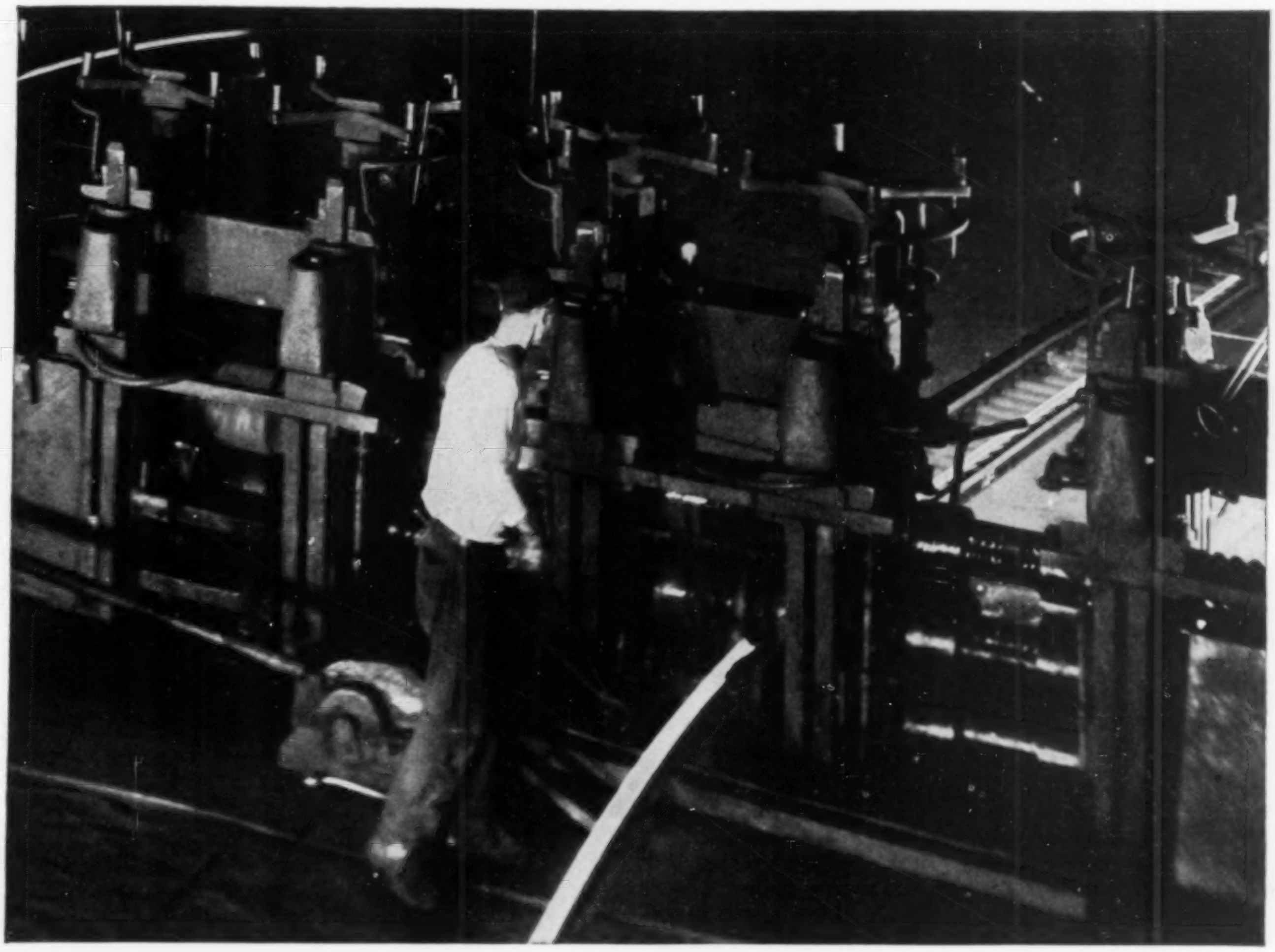
New Toronto, Ont.



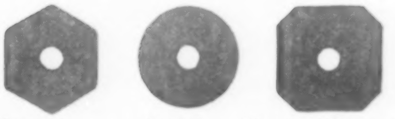
Care at every step makes it "THE OLD RELIABLE"

A tour of our tool-steel mill demonstrates even to the layman the scrupulous care observed at every stage of the production of Bethlehem Hollow Drill Steel. Selected raw materials are melted in modern furnaces, refined under slags of controlled analysis, and tested chemically before blooming. The entire surface of the blooms is removed; then follows the rolling into billets, the billet preparation, billet drilling, and the final rolling with the metallic core inserted. These are the high spots of the sequence of operations.

Sometimes visible at the mill, but more often at work behind the scenes, the quality-control inspectors and metallurgists are on the job. Testing, checking, inspecting, rejecting, approving, trouble-shooting. There are tests for chemical analysis, cleanliness, soundness, hardness, surface, depth of chill, grain size, uniformity, fatigue-resistance. These controls, and others, make certain that you will get the same good service from each shipment of Bethlehem Hollow Drill Steel.

Yes, there's a great deal more than meets the eye in a bar of Bethlehem Hollow. Every pound of it we ship is made to the same, undeviating standard of quality. That's why so many hard rock men call this fine drill steel the "old reliable."

SECTIONS AND SIZES



Hexagons	Rounds	Quarter-Octagons
7/8	7/8	7/8
1	1	1
1 1/8	1 1/8	1 1/8
1 1/4	1 1/4	1 1/4
	1 1/2	

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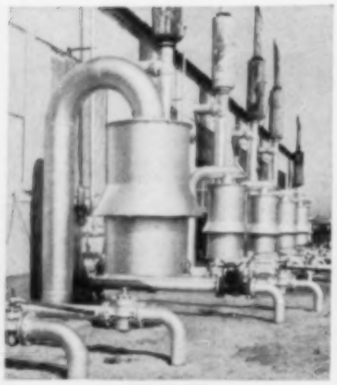

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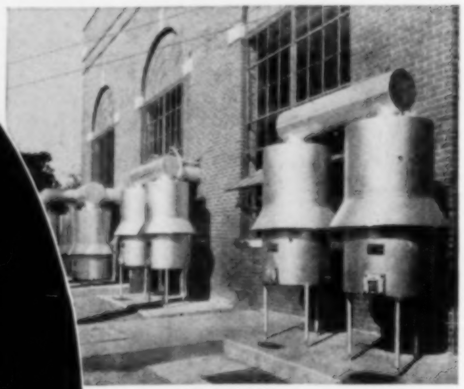
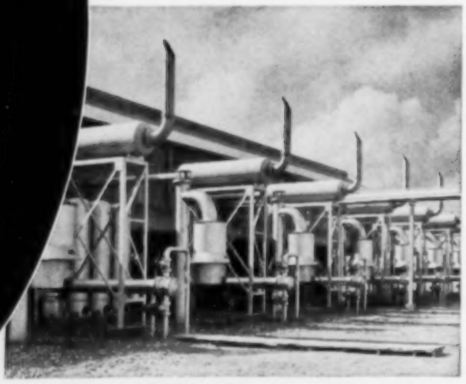


OKLAHOMA

TENNESSEE



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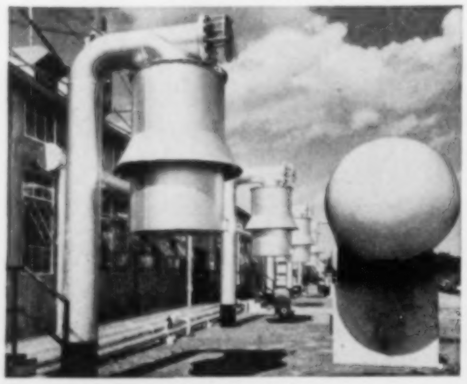

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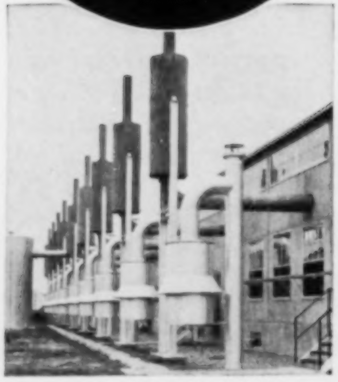

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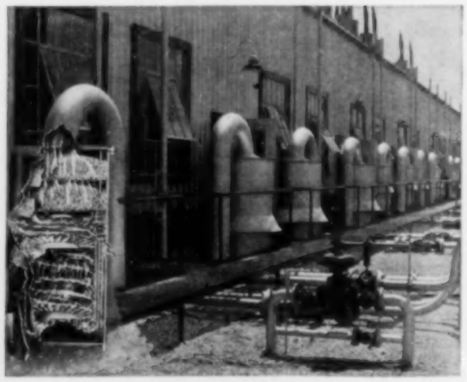

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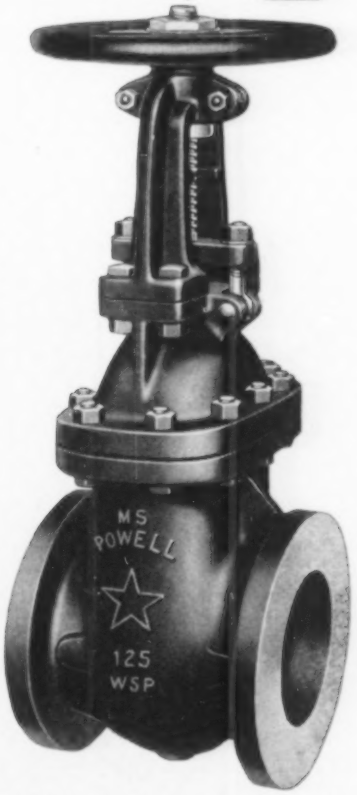

Fig. 1444—Large 125-pound Iron Body Bronze Mounted Gate Valve. Has flanged ends, outside screw rising stem, bolted flanged yoke and taper wedge double disc.

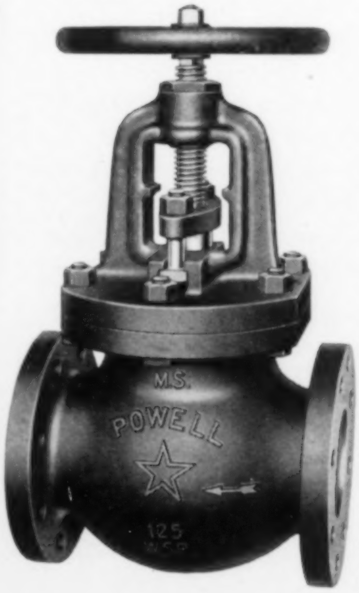

Fig. 301—125-pound Iron Body Bronze Mounted Globe Valve. Has flanged ends, outside screw stem, bolted flanged yoke, renewable bronze seat and renewable composition disc.

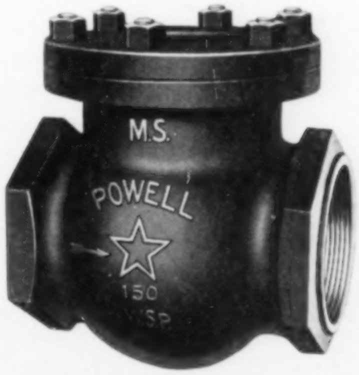

Fig. 311—150-pound Iron Body Bronze Mounted Horizontal Lift Check Valve. Screwed ends, bolted flanged cap, renewable bronze seat and union vulcanized composition disc.

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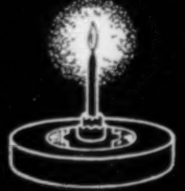

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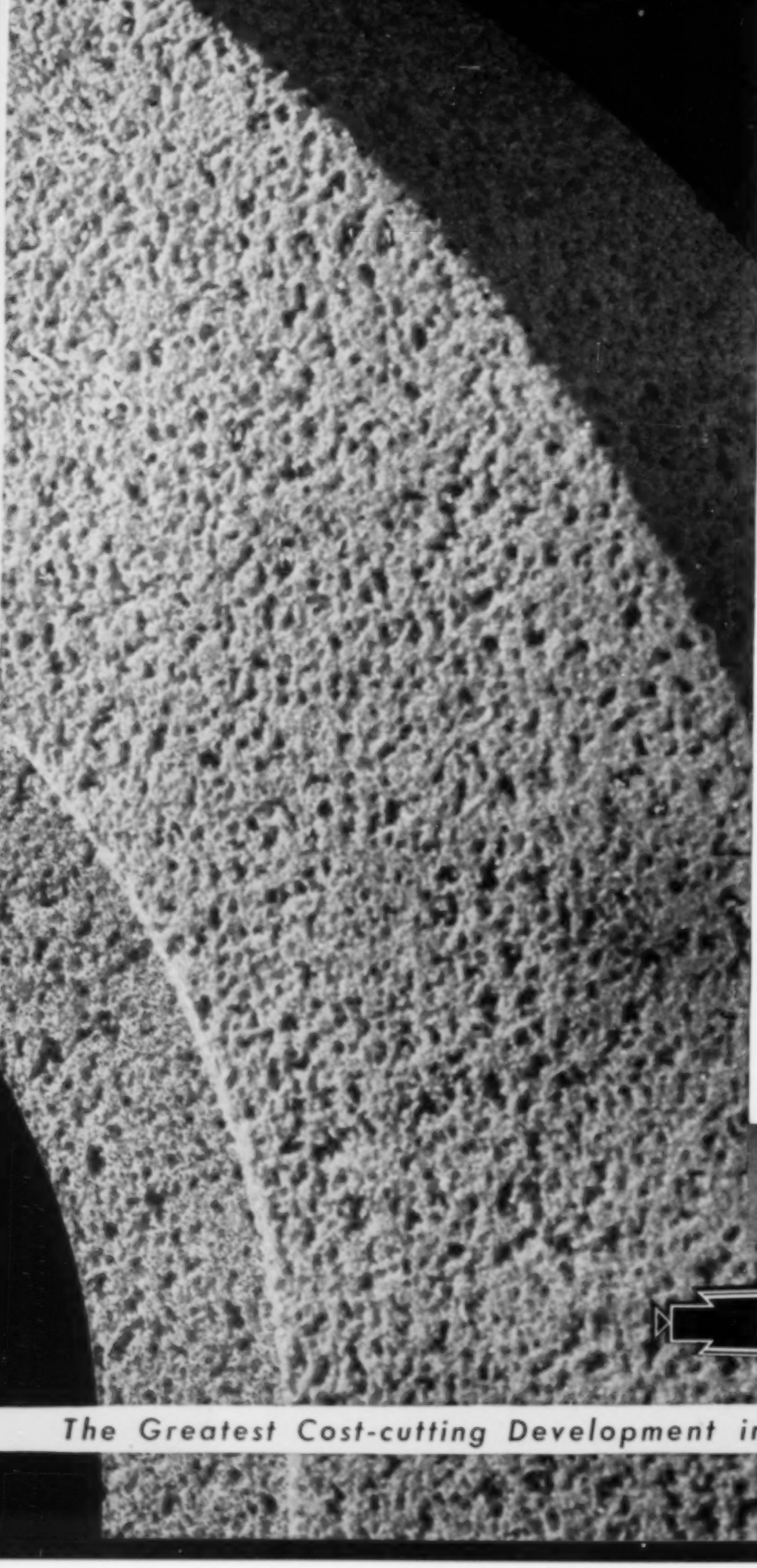

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Compressed Air Magazine

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ON THE COVER

JUST north of Governors Island, in New York Harbor, an island has been formed in water almost 50 feet deep by depositing clay and sand. Directly under it, at a depth of 135 feet, motorists will pass through the twin tubes of the Brooklyn-Battery Tunnel sometime in 1949. Fresh air will be blown in and vitiated air withdrawn through three ventilation buildings, one of which will be on this tiny island. Our cover picture shows basal members of a steel caisson, approximately 111 feet long and 51 feet wide, that is being sunk there 77 feet to bedrock. Its interior is divided into three compartments through which the material is dredged. The spaces between and around the open wells are filled with concrete. As the caisson descends, by its own weight, new sections are added at the top. After it has been seated and sealed in bedrock, shaft sinking in the rock beneath it will continue to make connections with the tubes. The octagonal building to be erected on top of the caisson will contain twelve blowers and twelve exhaust fans. This phase of the tunnel project is being executed by the Grow Construction Company.

•

IN THIS ISSUE

NUMEROUS improvements are being made by the Chesapeake & Ohio Railway to permit faster and safer operation of both passenger and freight trains. As one step in this program, it has driven the 2430-foot Fort Spring Tunnel to straighten a section of its roadbed and to shorten it by 3600 feet. Our first article describes this undertaking.

•

ALTHOUGH conceived centuries ago, the covered bridge still survives and continues to surprise engineers by its serviceability and durability. Our article is concerned primarily with old Delaware River bridges. (Page 240)

•

THE concluding installment of the Brooklyn-Battery Tunnel article that was begun last month describes work at the Manhattan end and at the ventilation shaft near Governors Island.

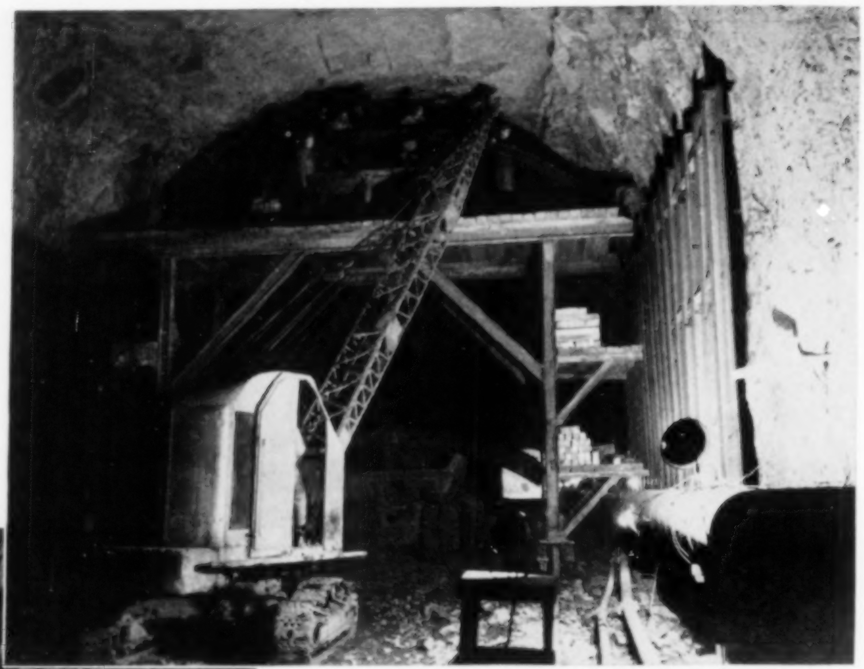
•

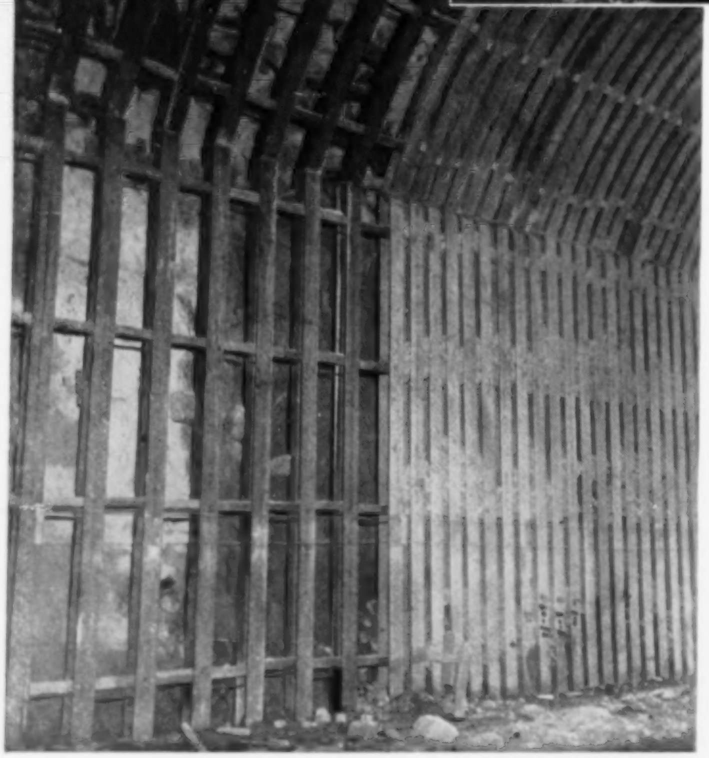
MONTANA IRRIGATION TUNNEL WAS FIRST THROUGH DIVIDE

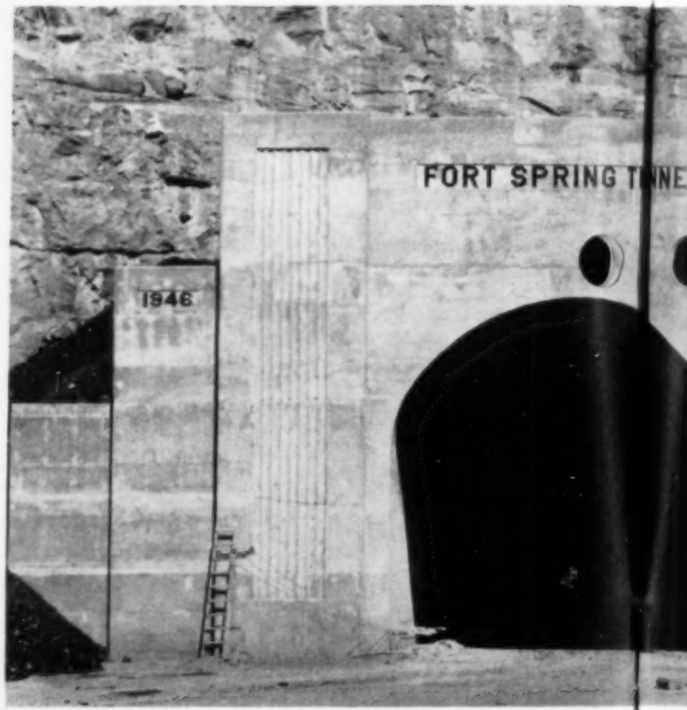
FROM Guayaquil, Ecuador, Frank Trask, Jr., informs us that we erred on page 178 of our July issue by stating that the Alva B. Adams Tunnel in Colorado is the first bore to carry irrigation water through the Continental Divide. Although few people know it, Mr. Trask reports, a similar but much shorter tunnel has been in service in western Montana for 40 or 50 years. Driven entirely by hand, the bore carries water from Indian Creek, a tributary of the Boulder River, to Peterson Creek in Deer Lodge Valley. The flow is from east to west, just the reverse of the Alva B. Adams Tunnel. According to Mr. Trask, "a farmer just went to work with a miner or two and paid for the job."

New Tunnel Shortens Rail Line

William S. Powell







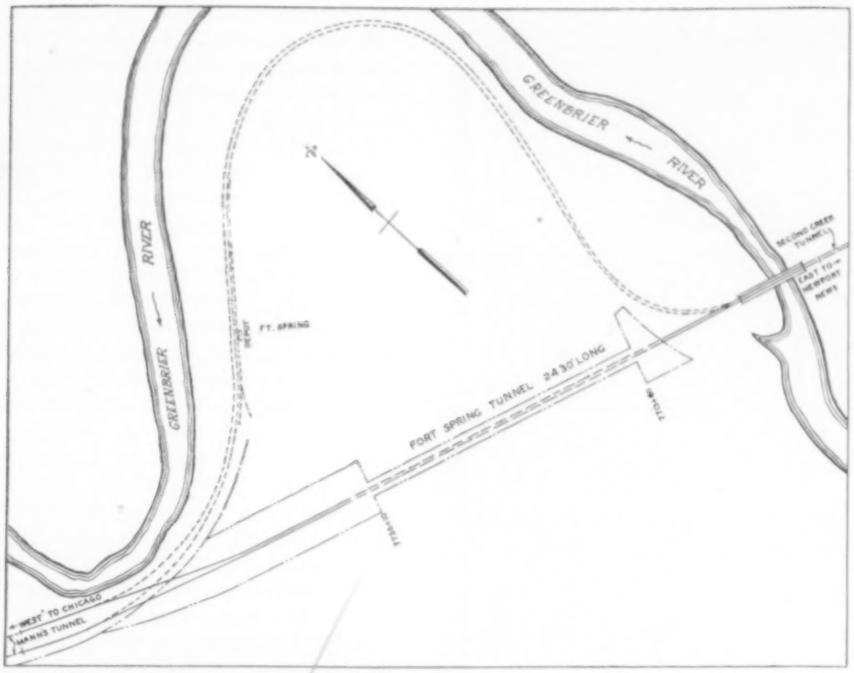
TOP AND LEFT PHOTOS, COMMERCIAL SHEARING & STAMPING COMPANY

THE EAST portal of the new double-track Fort Spring Tunnel on the main line of the Chesapeake & Ohio Railway is about 18 miles west of White Sulphur Springs, W. Va., and stands as a symbol of achievement as well as a monument to men: to engineers with foresight and imagination, to contractors with common sense and intelligence, to men who toil and build with their hands and who pave the way with sweat, and perhaps an occasional tear.

The portal is ultramodern in design, and at first glance resembles the face of a modern streamlined building. Its appearance, however, is deceptive, for it is not only a structure of architectural beauty but also supports a mountainside. In its walls are 2200 cubic yards of concrete to retain the ground behind it and prevent it from sliding down onto the tracks.

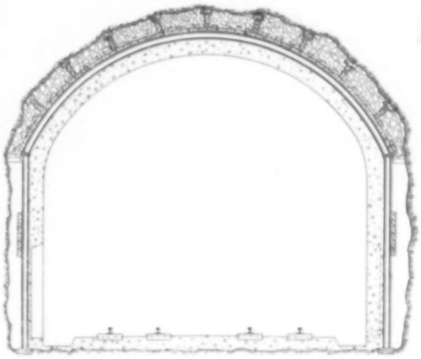
From an engineering standpoint, the Fort Spring Tunnel constitutes one of the most interesting and outstanding construction jobs of its kind undertaken in recent years. Work was begun on March 26, 1946, and is now nearing completion. It is expected that trains will be running through it by the first of next year. The new project eliminates 303 degrees of curvature and shortens the roadbed by 3600 feet. Further, it obviates a 35-mile-per-hour slow order at this point and is expected to result in a saving in operating expenses of $80,000 annually.

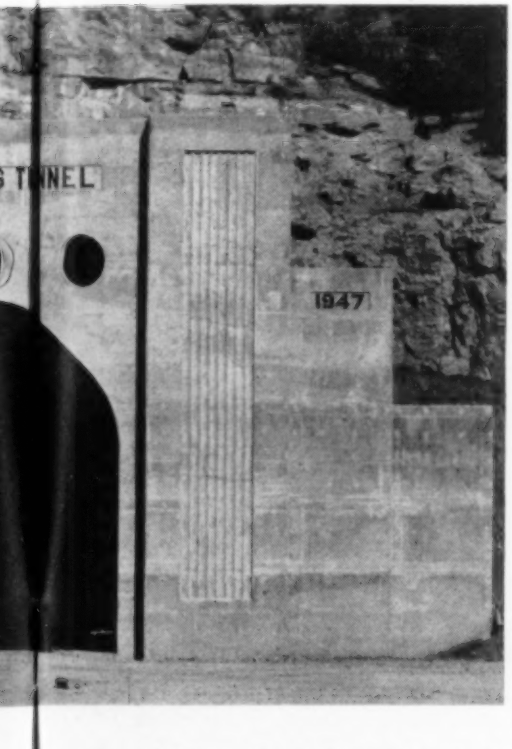
The construction of the tunnel is in keeping with the policy of the Chesapeake & Ohio to straighten all its tracks as much as practicable and to prepare the roadbed in anticipation of the streamlined trains which are now being built for the faster passenger service that is to be inaugurated soon. The end in view is to reduce travel time by accelerating train schedules, and one way of doing this is by eliminating curves.



PLAN AND SECTION

The curving dotted lines in the sketch at the left indicate the present circuitous route over which trains have to slow down to 35 miles an hour. The tunnel will shorten the roadbed by 3600 feet and permit higher running speeds. The drawing below shows a typical tunnel section, with 8-inch steel supports, 18-inch concrete lining, and rails in place. As excavated, the bore had a normal width of 39 feet and a height of 33 feet. The finished section is 32 feet wide and 27 feet high in the center of the arch. Refuge niches have been left in the concrete at 200-foot intervals on both sides for the use of trackmen when trains are going through.





In addition, the management of the C & O seeks even greater safety, convenience, and comfort for its patrons than they now enjoy. The Fort Spring Tunnel is only one of a number of projects underway and under consideration today for safer and faster operation of passenger trains. However, shortening of the roadbed also materially affects freight-train schedules, and it is planned to speed up this service as well and thus make possible faster deliveries of through carload shipments between the East and the West.

The building of the Chesapeake & Ohio at the outset was a gigantic task, because two huge mountain ranges had to be crossed—the Blue Ridge and the Alleghenies. However, the men who surveyed and ran the line over and through those mountains were experts, for even today the railway is noted for its easy grades. It was in 1853 that the Board of Public Works of the State of Virginia granted the Covington & Ohio Railroad the right to construct a line over the Alleghenies. It was believed, and rightly so, that some day railroads would supplant canals throughout the country as a means of transportation.

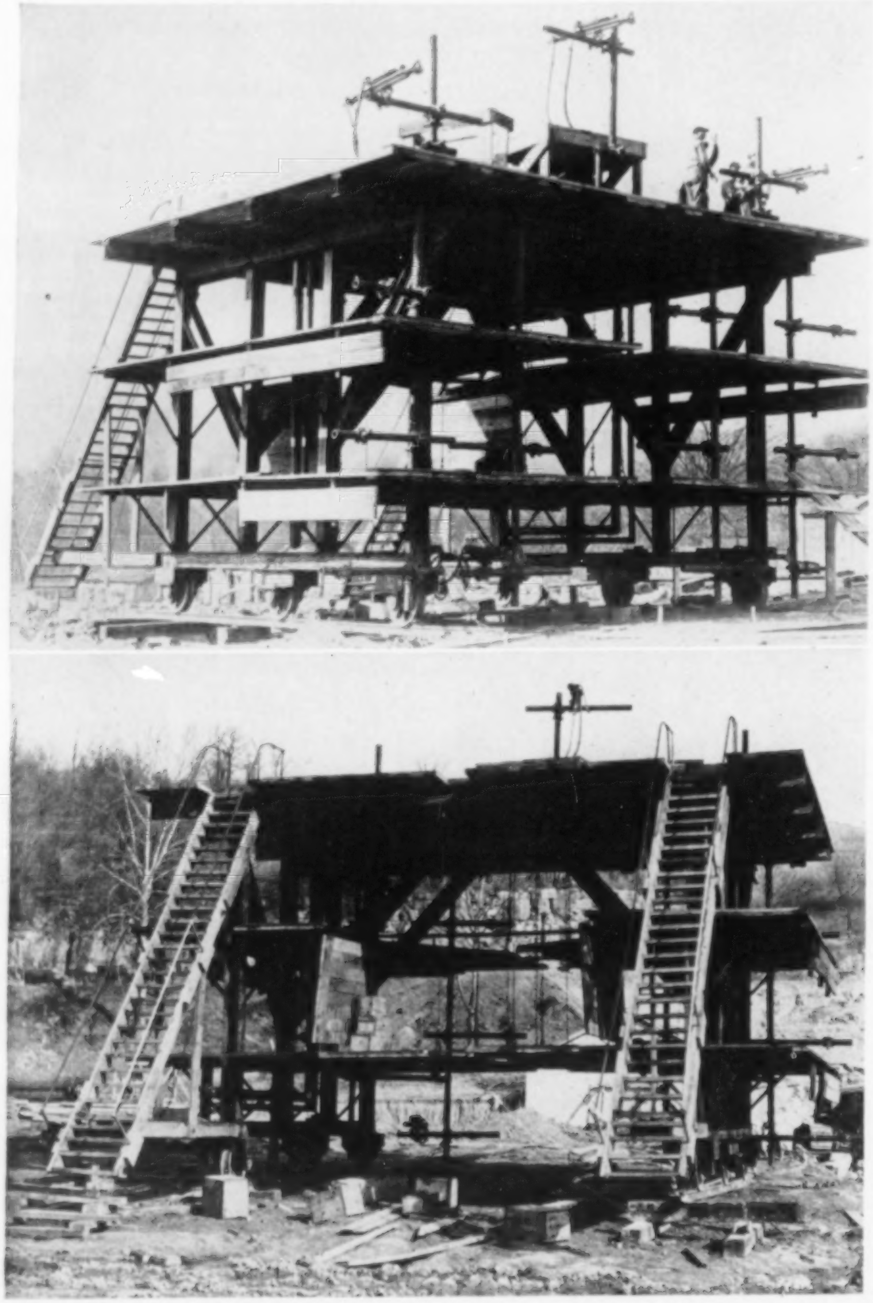
At that time the Ohio River formed the western boundary of Virginia, and the authorities were anxious to have a rail line extended to that point. It was also desirable that the road should pass through White Sulphur Springs in Greenbrier County, for that resort had become so famous that it was necessary to provide it with railway passenger and freight service. Work on the line was suspended during the Civil War, but was resumed in 1869 after Collis P. Huntington had gained control of the Chesapeake & Ohio Railroad Company, organized August 13, 1868. A year later, rails were laid to White Sulphur Springs, and at some points trains were operated over temporary tracks before the permanent roadbed was carried farther west.

In 1873 the Chesapeake & Ohio finally reached Huntington, then a small town that had been incorporated February 27, 1871, in the new State of West Virginia. Since that time it has expanded and improved its facilities until today it is one of the country's outstanding railroads. Its main lines now run from Washington and Norfolk through Richmond, Charlottesville, Clifton Forge, White Sulphur, Charleston, and Huntington on to Cincinnati, Toledo, and Detroit. A branch extends from Ashland to Lexington and Louisville, all in Kentucky.

When the plans for the Fort Spring Tunnel were being made, several important matters had to be taken into consideration. In the first place, the rock formation along the tunnel line and in the surrounding countryside is of the Mississippian period, known geologically as Greenbrier Limestone, and the entire area has subterranean drainage through sinkholes. The whole region is underdrained by a great system of caves and caverns. Consequently, the engineers had to be careful in their selection of tunnel supports.

CONSTRUCTION VIEWS AND EAST PORTAL

The concrete structure at the east entrance to the tunnel (center) is more than an architectural decoration. It contains 2200 cubic yards of concrete and is designed to prevent dislodgment of the overlying rock. At the top-left, a crew is seen setting prefabricated steel arch ribs on side posts to support the roof. The ribs were brought in on trucks and raised by a crane to the working platform of a jumbo that traveled on steel rails. At the lower right in the picture is the 26-inch air line for ventilating the workings. Details of a section of steel supports are illustrated at the extreme left. Old quarry operations had reduced the rock cover over the west entrance and shattered what remained to some extent so that steel posts with mating arch ribs had be set on 1-foot centers to a point some distance in from that portal. This picture shows where a changeover was made to the 2-foot spacing that generally prevailed throughout the bore.



DRILL CARRIAGE

Two views of the 32-ton jumbo from which the drilling was done. Fifteen drifters were mounted on and below its three working platforms, which were spaced 8 feet apart. The inner sections of the two lower platforms were collapsible and, when removed, permitted a power shovel or truck to pass through the carriage. Railed-in stairways at the rear provided safe travelways for the drilling crews.

Formerly, it was the custom to use timbers, but since the Fort Spring Tunnel was to be double-tracked, with ample clearance for modern equipment, the over-all width had to be greater than usual. If timber supports had been decided upon, the bore would have had to be of larger section to insure ample clearance, and that would have made the job more cumbersome and necessitated an increase in yardage excavated as well as in the amount of concrete required for the lining.

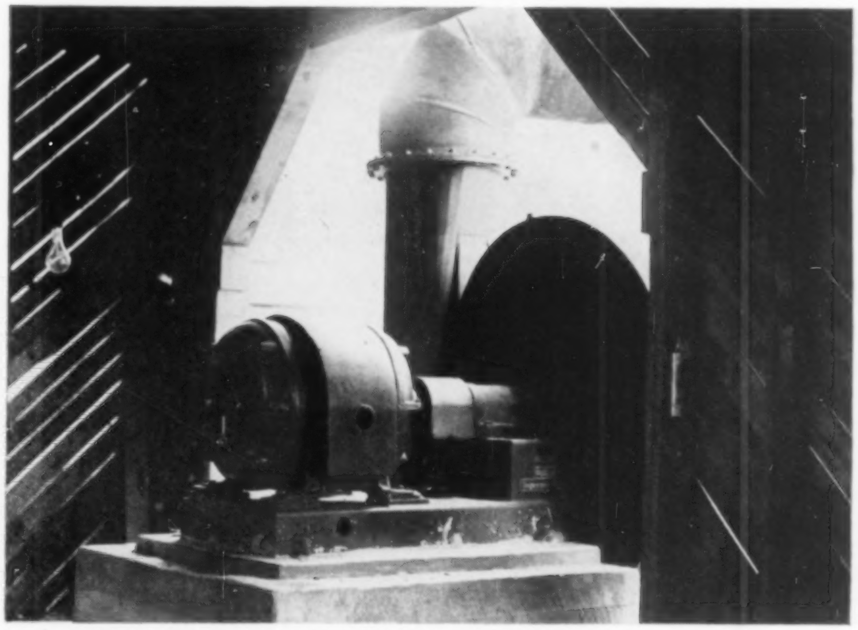
As a result, the engineers chose a modern type of steel support not only to lessen tunneling and concreting but also to expedite construction. The entire footing on both sides of the bore was poured before any other concrete work was done, and this permitted easy movement of the collapsible steel forms used in lining the tunnel. They are new in design and easily collapsed by releasing jacks on the bottom. The forms are 60 feet long, are rigged on the same portable jumbo that was used for the drilling operations, and are equipped with wheels to travel on steel rails. As soon as one section is poured, the entire outfit is moved forward 60 feet and the cycle repeated.

At the time this article was written, lining had just been begun and the engineers said it would take approximately four months to complete the job. The concrete is discharged from truck mixers into a hopper at the foot of a 30-inch by 60-foot conveyor. This carries the material to a reservoir from which it is pumped through steel pipe lines and 8-inch special rubber hoses at the ends of the pipe lines. Lining the tunnel with concrete is another example of the railroad's policy to do everything possible for the safety of the public.

Drilling was begun on March 26, 1946, at the west portal. Fifteen drifter drills using 1¼-inch hollow, round steel with detachable bits were mounted on the jumbo, and seven diesel-powered portable compressors, each with a capacity of 500 cfm., furnished air at 100 psi. to operate them. Wet drilling was employed throughout to keep down the dust, and water for the entire job was obtained from a well, 140 feet deep, drilled near the site. It was pumped into tanks placed high enough on a hill to insure water at 100 pounds pressure at the drills. The well also supplied the workers with drinking water.

The tunnel was driven 2280 feet from the west portal and 440 feet from the east portal, and was holed through on March 5, 1947. Heavy ground was encountered at the west portal soon after excavating was begun, and two rib drifts, 10 feet high and 5 feet wide, were driven at grade. After each had been advanced a distance of 20 feet a top bench was drilled and blasted to increase the height to 22 feet. It was then that the concrete footing was poured so that steel posts could be set to grade. These were placed on 12-inch centers in both drifts throughout the full 20 feet. Short holes, about 1 foot deep, were next drilled around the roof line so that enough rock could be removed to permit erection of the steel posts, one pair at a time. This procedure was kept up until all the posts were in position and connected by steel tie rods and timber separators. It was then that the center core of rock was excavated by benching with Jackhamers and the blasted rock was removed from the rib drifts by a pan scraper. Blasting was done with 40-percent ammonia gelatin in 1¼x8-inch cartridges. The charges were primed with No. 6 electric blasting caps detonated by a 50-hole blasting machine.

Before solid rock was struck, about 100 feet in from the west portal, progress had been rather slow because of clay seams and clay pockets in the limestone. Once in solid rock, the engineers decided to change to the full-face method of



VENTILATING BLOWER
This 200-hp. machine sent 25,000 cfm. of fresh air into the workings during the drilling and blasting operations. The air was delivered through a 26-inch line.

blasting and to increase the spacing of the steel supports to 2 feet and, later, to 2½ feet. Until that time the east portal had been inaccessible; but, with the completion of a construction road, work was begun there on June 1.

The formation at the east end changed quickly from a solid face of limestone to one intermixed with clay seams, but it was not bad enough to prohibit the full-face method of blasting. Steel supports were again placed on 1-foot centers and carried up to the heading. In the beginning, center cut holes along with a few relievers were shot first, and next trim holes were fired separately with lighter charges of explosives.

Good progress was made, but bad places were encountered many times during drilling. The underground caverns and caves characteristic of the region made the work hazardous, and the contractor had to keep continual watch for anything that might hinder operations. At one point a cave or cavern extended approximately 58 feet along the tunnel roof and about 47 feet above it. This was packed solid with timber and will eventually be sealed with concrete to prevent further caving. Excavating, however, continued on schedule

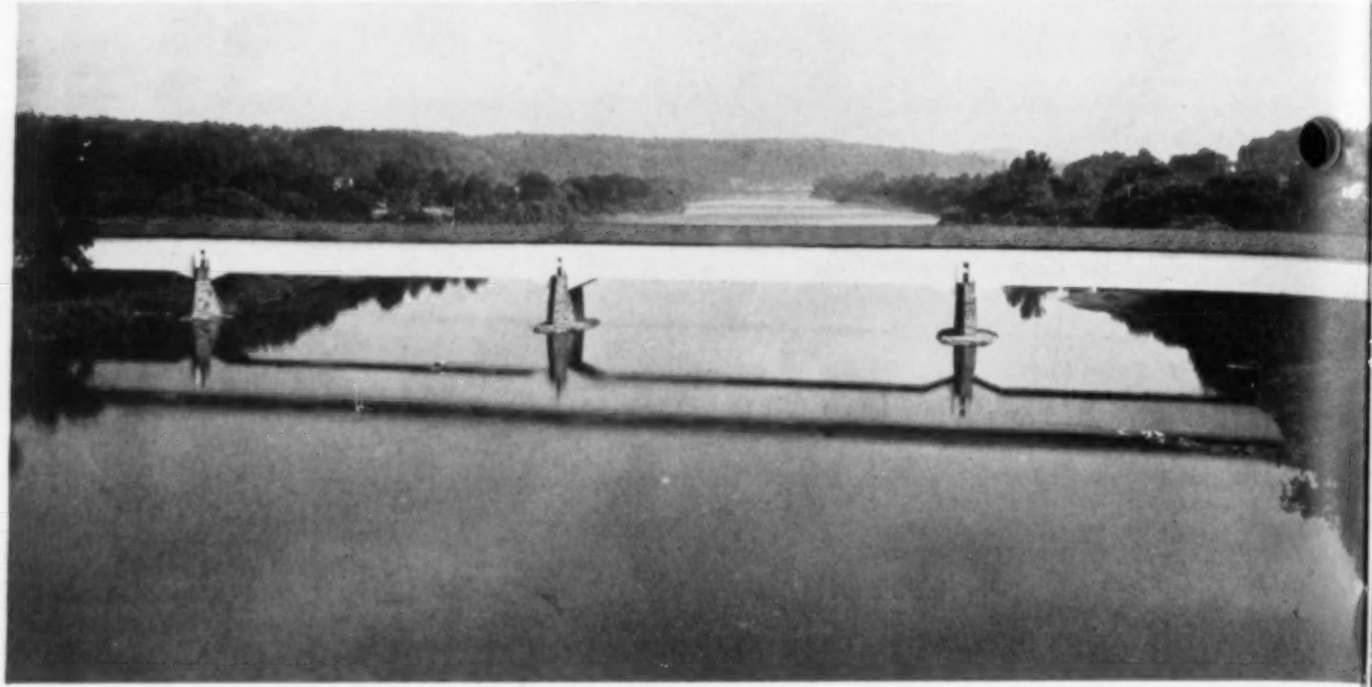
At the west end of the bore the broken rock was loaded into 12-cubic-yard dump trucks by a 1½-yard diesel shovel and hauled to a dump, where it was reloaded into 2-way side-dump railroad cars of 20-yard capacity. Rock that was suitable for ballast was transported by trains of twelve cars, including a ballast spreader, to a nearby crusher, where it was reduced and delivered to the railroad. A ¾-yard air shovel served at the east end. During the drilling and blasting operations, ventilating air was furnished by a 25,000-cfm. centrifugal blower driven by a 200-hp. motor and was carried to the working face by a 26-inch-diameter pipe line.

The jumbo that was used for drilling and blasting and that is now being utilized in pouring the concrete lining is an interesting piece of machinery. It was designed and built on the job by the contractor. It is 26 feet in length, overall, 33 feet wide, and 22 feet high, and has a movable bench-type platform at the top that permits increasing the height to 27 feet. It weighs 32 tons without equipment and is provided with flanged wheels so that it can be rolled into and out of the tunnel on rails.

The carriage has three working platforms spaced above one another at 8-foot intervals. The bottom two are collapsible and are raised and lowered by cables. The drifter drills with which it was equipped were mounted on columns at the driving end, and stairways with hand rails for safety were built at the rear When in use, four drills were operated from the tunnel-floor level, four each from the first and second platforms, and three from the topmost one. The crown trim holes were drilled from the movable bench platform. When the collapsible platforms were removed there was plenty of room for the power shovel and trucks to pass through the jumbo. As soon as the bore has been lined throughout with concrete, the muck that has been left to serve as a roadway will be excavated down to solid rock, the floor will be concreted, and the 131-pound rails will be placed on short ties embedded in the concrete. About 100 men were employed on this construction job, and the contractor has handled the work with such care that no serious accidents have occurred.

SOURCES OF COMPRESSED AIR
Four of the seven diesel-engine-driven portable compressors that furnished 3500 cfm. of air at 100 psi. pressure for operating rock drills and allied equipment.

The Fort Spring Tunnel is in a direct line with the New Second Creek Tunnel, a recent double-track passageway east of it, and with the New Manns Tunnel on the west, except for a slight curve (see map). The two latter were completed by the Chesapeake & Ohio in 1932 and 1933 to relieve traffic through the then existing tunnels. However, looking ahead, the railroad had made plans for the driving of the Fort Spring Tunnel between New Second Creek and New Manns tunnels on a grade of 0.34 percent, or about 4 inches in 100 feet, the grade ascending eastward. Its cost has been estimated at approximately $2,225,000, but the expectations are that the shortened roadbed will enable the C & O to save on maintenance and upkeep, in addition to speeding up both freight and passenger trains



FINAL DELAWARE RIVER COVERED BRIDGE

Opened 78 years ago, this structure, called the Columbia Bridge, still carries traffic between Columbia, N. J., and Portland, Pa. The general view, above, was taken in August of this year from a railroad span upstream. The portal of the Pennsylvania end is at the upper-right. The picture of the interior, right, shows details of the truss structure and its double-arch reinforcing member. The arch was strengthened in 1929 following a cyclone that tore off sideboards and roofing slate. The sag of the floor can be discerned by the white dividing line for traffic which appears to be curved instead of straight. New floor boards have been laid over the old ones from time to time until the cumulative thickness is said to be about 5½ inches. Old records give the following scale of tolls: sheep and swine, two cents; cattle, three cents; horse and rider, ten cents; single-horse rig, fifteen cents; team and wagon, twenty cents; man, wife, and family, 50 cents monthly. Passage has been free since 1927. Officers are continually on duty to enforce the speed and weight laws for vehicles. The bridge was used by 568,188 motorists last year. In 1903, when the Delaware rose 31 feet, the floor boards were under 16 inches of water, but the structure sustained little damage.

Covered Bridges

C. H. Vivian

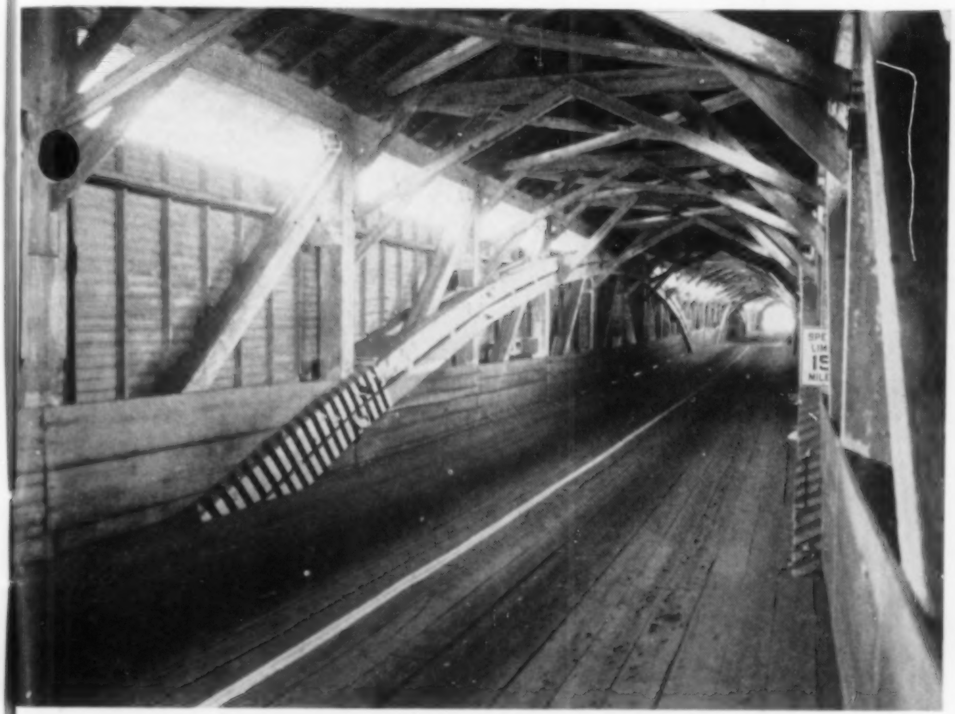
THE covered bridge and the covered wagon typify a pioneer era in this country. The two can be grouped to that extent, but little further. The lumbering conveyance, with its arched top, was conceived in the Conestoga area of Pennsylvania to transport gold seekers and colonists westward. It served this purpose admirably, and continued to fill a need on the new frontiers for several decades. It not only carried individual families and their produce but even entered briefly the realm of big business in the mass freighting of various commodities, most spectacular of which was the hauling of borax out of Death Valley. Gradually, however, it was displaced, and with the coming of the automotive age virtually vanished from the scene. Its period of duty measured roughly 50 years.

Contrasted with this, the covered bridge goes back at least seven centuries. It is, of course, not an American conception, but it did probably attain its greatest use on our shores. Moreover, it is not a rarity today, nor has it yet become outmoded. Although millions of Americans have never seen such a structure, plenty of them are still standing. Richard S. Allen, of Round Lake, N.Y., the leading statistician as to covered bridges, has compiled figures showing that there are more than 1200 of them in service in four states. Ohio leads with 592, and then come Pennsylvania with 336, Indiana with 194, and Vermont, 170. Most surprising of all is the fact that they are still being constructed.

In the cities and on main traveled highways, these wooden structures are ill fitted for the traffic, but in remote areas they are not only useful but also the most economical type that can be built. In the heavily forested sections of California, for instance, they can be and are being put up at a saving over steel spans because of the cost of hauling in the material. In addition to the hundreds still in service, numerous old covered bridges have been preserved as museum pieces. Henry Ford has several of them in his Dearborn collection of Americana, and some states have moved disused ones to state parks and set them up over streams where they can be preserved for posterity.

Covered bridges are found in all wooded regions from Norway to China. There is no record of where or when the first one was constructed, but some are very old. The Kapell Bruecke over the Reuss River in Luzern, Switzerland, was built in 1333, and one over the Rhine at Stein-Sackingen dates from 1685. Others in Europe are recent, one over the Neckar at Thalhausen having been erected in 1924.

Their picturesqueness leads many people to assume that the bridges were covered for the sake of appearance, but this is not true. The superstructure is entirely utilitarian. Between piers and/or abutments, the spans are supported at the sides by trusses. Somewhat like their steel counterparts, these assemblies have an upper and lower chord, with the latter rising above floor level.



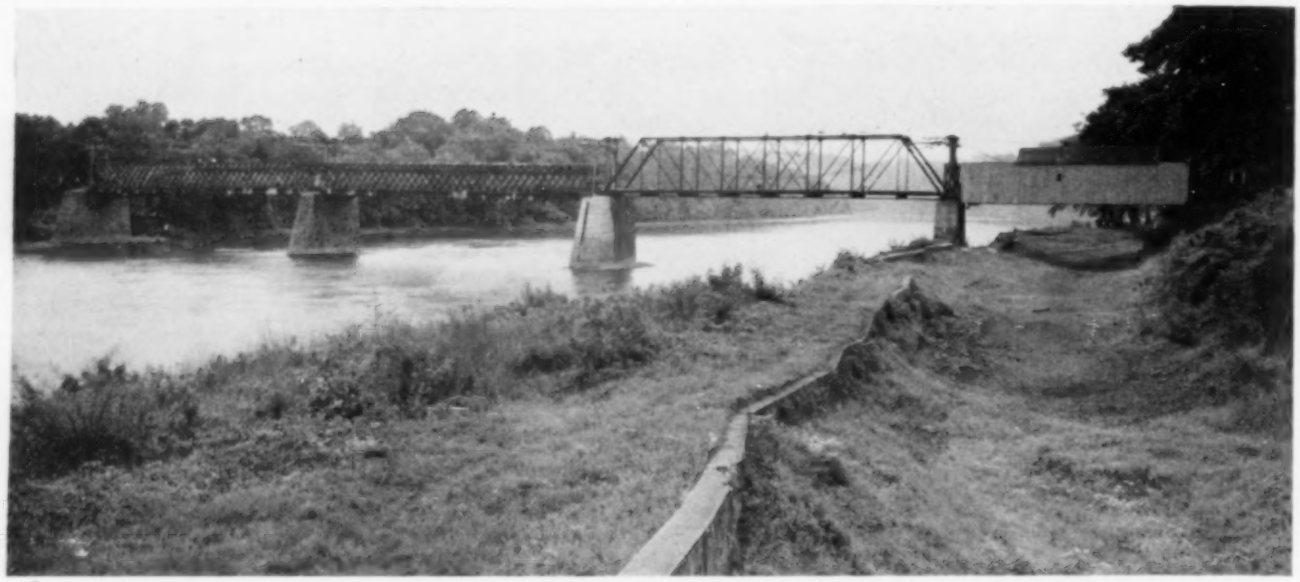
Originally, these trusses were left open to the weather, but when it was found that the elements hastened their deterioration they were covered, tops and sides. This gave them a good measure of protection, but the deck structure was still exposed to rain and snow.

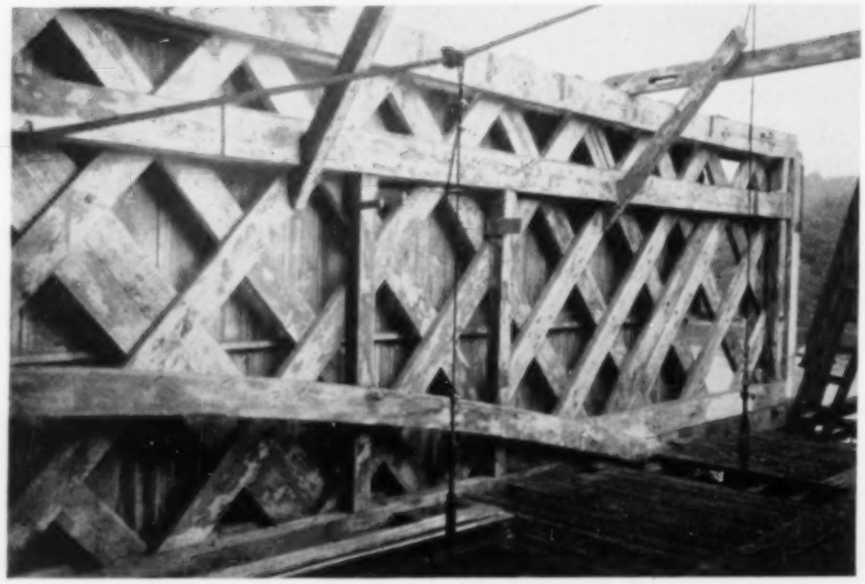
Because the bridges were often shifted or even blown off their supports by gales, someone reasoned that they could be given greater protection from both moisture and wind by covering them completely, and experience has proved this to be true. In this country, the early builders didn't enclose them, and there followed a period when the pros and cons of a covering were argued widely. By 1810, however, it had been clearly established that roofing greatly increased their durability, and the practice became general.

Proof of the correctness of this theory has been obtained whenever an old covered bridge has been dismantled. Invariably, the timbers have been found to be firm and sound and there has been a keen demand for them. In his profusely illustrated book, *The Covered Bridge*, which concerns itself principally with Vermont, Herbert W. Congdon tells of an enterprising man in Bennington, Vt., who converted a section of such a span into a store shortly after the close of the Civil War. Since then it has, in turn, been a lunchroom, a dressmaking establishment, a tin shop, a speak-easy, and is currently occupied by a barber. It is said to be sounder than most of its neighboring structures. He also recounts the story of a match-manufacturing concern that bought the pine frame of a decommissioned bridge only to discover that time and vibration had so hardened the wood that it was useless for the intended purpose. But the broadest use made of the old timbers has been in putting up farmers' barns.

Few builders of covered bridges had more than a meager knowledge of civil engineering. Practically all of them were skilled carpenters who put the component timbers together with consummate care, but without the aid of detailed plans. They knew the strength of the woods with which they worked, and no doubt made the sections heavy enough to provide what modern technical men call the factor of safety. Occasionally one of their creations failed, but so, too, have some of our precisely engineered modern steel spans. On the whole, the record of the covered wooden bridge is worthy of envy by today's builders. Most of them have lasted longer than was considered possible, and they are carrying loads far in excess of those originally intended for them.

Mr. Congdon says that these pioneer craftsmen worked "by guess and by gosh." Most of the crossings were made "a load of hay" wide and high. Their portals were partly closed in at the top to keep out rain, and they were arched no doubt with a view to allowing loaded hayracks to pass through them unobstructed. Their designers did not foresee the day when square-shaped motor trucks would go through them; and, as a consequence, some of those entrances have suffered considerable damage. In lieu of elaborate drawings, most builders made models to assist them. Since the trusses were the important load carriers, a sample panel was fabricated with great care in a field near one end of the site and served as a template for the others. Ends that joined were cut to fit with great accuracy, and their overlapping sections were fastened together with oak pins, called "treenails." Ordinarily, these were about 2 inches in diameter and were soaked or even boiled in oil in order to increase their service life. The truss timbers themselves were hewn from logs that had been air-seasoned for two or three years. Pine, hemlock, and spruce were the most commonly used woods, with the two latter favored be-





LUMBERVILLE BRIDGE

These pictures were taken in August during the dismantling of the old structure and the erection, simultaneously, of a new suspension footbridge at the same site. At the right end of the view above, the covered span across the dry bed of the Lehigh-Delaware Canal is shown virtually intact. Next to it is a steel span that was built in 1903 after that section of the covered bridge had been destroyed by flood waters. Farther to the left, the removal of the roof and siding has exposed the latticed trusses of two spans. The fourth river span on the New Jersey side had already been taken down. The picture at the left shows details of one of the lattice trusses, with a part of the reinforcing arch slanting down toward the right, bottom. Both oak dowels, or treenails, and iron bolts were used as connectors. The wires belong to the new suspension bridge.

cause they are least affected by moisture.

When the truss members were ready, they were moved out on falsework or scaffolding that had been erected in the stream and that served as a support during their emplacement on previously prepared piers of native stone and mortar. With the trusses in position, cross members were put in between them and the stringers for the flooring added. The deck, usually of oak planks, was always cambered longitudinally to allow for settlement under load. New crossings were normally tested by driving a herd of cattle over them. In their dark interiors, the animals huddled together and, as they moved along, provided both a concentrated load and a high degree of vibration. In 1855, Nicholas Powers, one of Vermont's noted bridge builders, erected an extra-long single-span structure at North Blenheim in that state. The natives shook their heads dubiously and dubbed it "Power's Folly," but when it was opened to traffic it settled only a fraction of an inch.

The first trusses had inverted V-shaped members joining the upper and lower chords. In the center of each "V" was a post, called the "kingpost." Later, this was frequently replaced by an iron rod. A slightly different pattern used "queenposts." As longer spans were required to cross wider streams, new truss assemblies were developed. One of the first was a combination truss and arch invented by Theodore Burr, who bridged the Hudson at Waterford in 1804 with a structure that remained in service until it burned in 1909. Burr was granted a patent on his design in 1817 and it was applied, often in modified form, from then on. The arches, generally of massive size, were composed of segments hewn to shape.

The lattice truss, with criss-crossing members between the upper and lower chords, was patented in 1820 by Ithial Town of Vermont and thereafter was the most popular form in that state. It was easy to build, consisted entirely of wood, and gave warning when becoming weak. Town sold rights to the use of his truss pattern both here and abroad. It was often employed in combination with the Burr arch and was favored by railroad engineers—the Boston & Maine, as late as 1900, having in service 100 bridges of this type of construction. Another well-known truss design was patented in 1830 by S. H. Long. As iron became available, rods were substituted for some of the members that were in tension and bolts for the oak treenails. This marked the beginning of a transition period between the strictly wooden bridge and today's steel structure.

Covered bridges seem to have resisted windstorms well, but floods have taken a heavy toll. However, they were seldom carried far, and because they floated it was easy to salvage them. Oftentimes displaced spans were reconstructed at downstream points where they happened to lodge, but occasionally they were returned to their original sites. The development of modern mechanical equipment made these upstream movements easier than when only human and animal power were available. Mr. Congdon cites the case of the Hammond Bridge over Otter Creek, Pittsford, Vt., which was washed 1½ miles downstream in 1927. Oil barrels were lashed to it to increase its buoyancy and it was towed back and replaced on higher abutments.

The financing of covered bridges was a considerable problem, although their cost was ridiculously low as measured by present levels. Then as now, there were protests against increased taxes, which was a hindrance to building them with public funds. The average frugal Yankee preferred to ford streams at shallow places rather than be taxed for a bridge. Because of that sentiment, most of the structures were erected by private companies which charged tolls to get their money back. In many cases, lotteries were run to raise funds, the practice persisting despite the protests of church members. Bridges seem to have been provided primarily for the purpose of getting cattle to market. Once it became manifest that they offered safe, dry crossings of turbulent streams, people came to realize that they were worth the cost, and opposition to spending tax money for their construction subsided considerably. Consequently, in later years, it was not unusual for state governments to make outright appropriations or loans to companies to assist them in completing partially built structures when their own funds were exhausted.

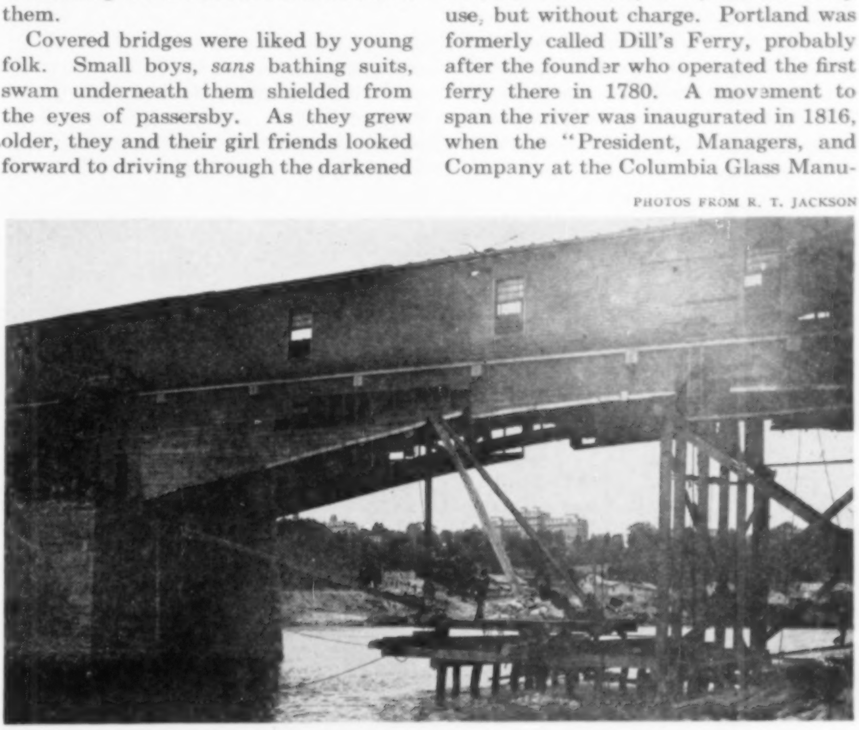
Tolls varied considerably in different sections of the country. In most states the return on the investment was limited by law. In Vermont it was 12 percent, and a typical list of tolls was: pedestrian, one cent; horse and rider, four cents; 2-wheel coach and passengers, twelve cents; 4-wheel coach and passengers, twenty cents; sheep and swine, ½ cent; and cattle one cent. In many places persons were allowed to cross free of charge when going to or from religious services. Special conditions oftentimes increased the earning power. For instance, when a tavern was located at one end only, then Saturday night was lucrative. From sad experience tipplers learned the wisdom of paying their return toll while en route to the tavern when they were in possession of their faculties and also the necessary money. Those who drank themselves broke sometimes "ran the bridge" to get over without paying. Others argued with the keeper until that exasperated individual was willing to let them cross to be rid of them.

Covered bridges were liked by young folk. Small boys, *sans* bathing suits, swam underneath them shielded from the eyes of passersby. As they grew older, they and their girl friends looked forward to driving through the darkened interiors and were glad to obey the regulation: "Horses at a walk." The structures were commonly called "kissing bridges," and many a bashful swain was emboldened to "pop the question" in their dusky recesses. Speed laws were rigorously enforced, and those who ran their horses were usually fined $2 for the offense.

The Delaware River, which flows past Phillipsburg, N. J., where this magazine is published, was at one time spanned by seventeen covered bridges, all of which replaced ferries. The first one was opened on January 30, 1806, and extended from Trenton, N. J., to Morrisville, Pa. It was 1025 feet long. The next one was placed in service on October 1, 1806, and joined Easton, Pa., and Phillipsburg, N. J. All were toll structures until comparatively recent years when they were purchased by the Joint Commission for the Elimination of Toll Bridges Between Pennsylvania and New Jersey.

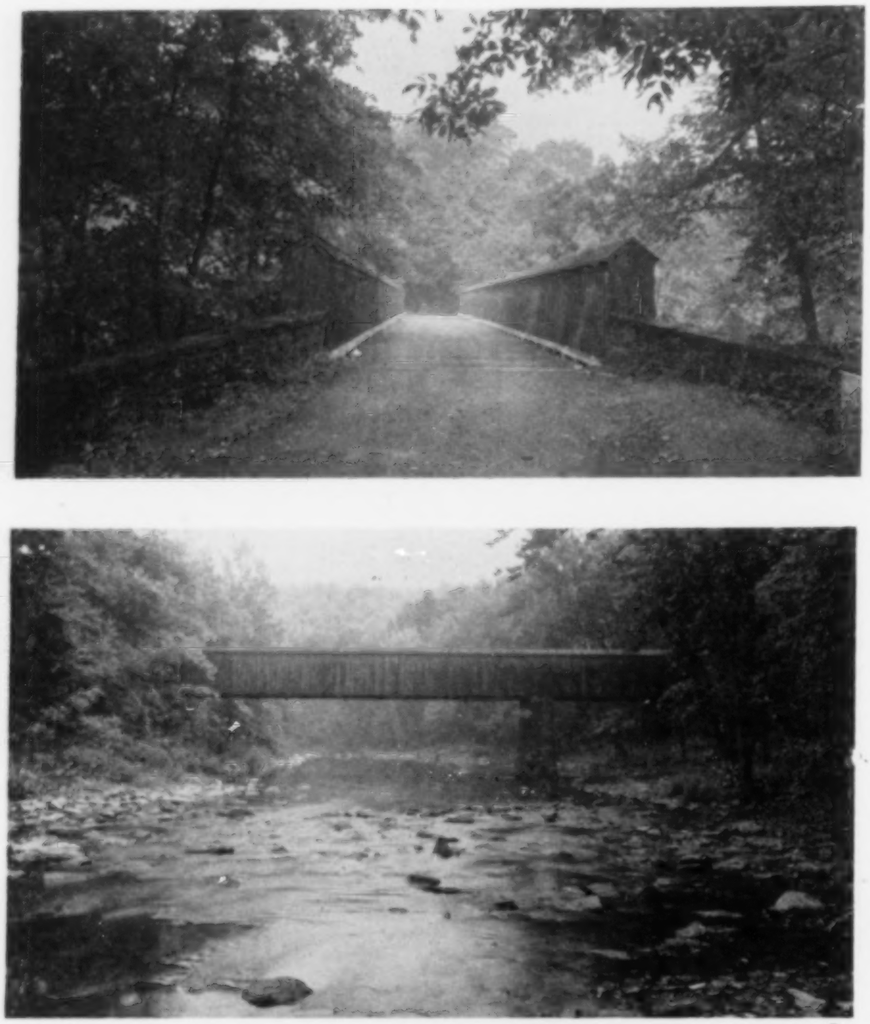
Only one of these Delaware covered bridges now remains. It links Portland, Pa., and Columbia, N. J., and is in daily use, but without charge. Portland was formerly called Dill's Ferry, probably after the founder who operated the first ferry there in 1780. A movement to span the river was inaugurated in 1816, when the "President, Managers, and Company at the Columbia Glass Manu-

PHOTOS FROM R. T. JACKSON



OLD BRIDGE AT EASTON

This structure across the Delaware connected Easton, Pa., and Phillipsburg, N. J., from 1806 to 1895, when a steel cantilever bridge was erected at the same site and on the same piers. The picture below shows its side windows and roof ventilators, as well as the camber or curve by which builders allowed for settlement under load. The other view, date unknown, was evidently taken while repairs, probably necessitated by flood damage, were being made. The camera was pointing upstream, and the large structure in the background is Pardee Hall on the campus of Lafayette College in Easton.



TRANSITION TYPE

On the early wooden bridges the supporting trusses were open. Later builders enclosed them to protect them from the elements, and the next step was to heighten the sides and put on a roof. The example of the intermediate type shown here spans Tohickon Creek in Ralph Stover Park, Pa. As seen from the stream level (lower view) it looks like a covered bridge.

factory" obtained a charter from the New Jersey state legislature. A financial panic nipped the enterprise in the bud, and supplemental charters extending the time for the construction of a bridge were issued in 1824 and again in 1832, but work did not begin.

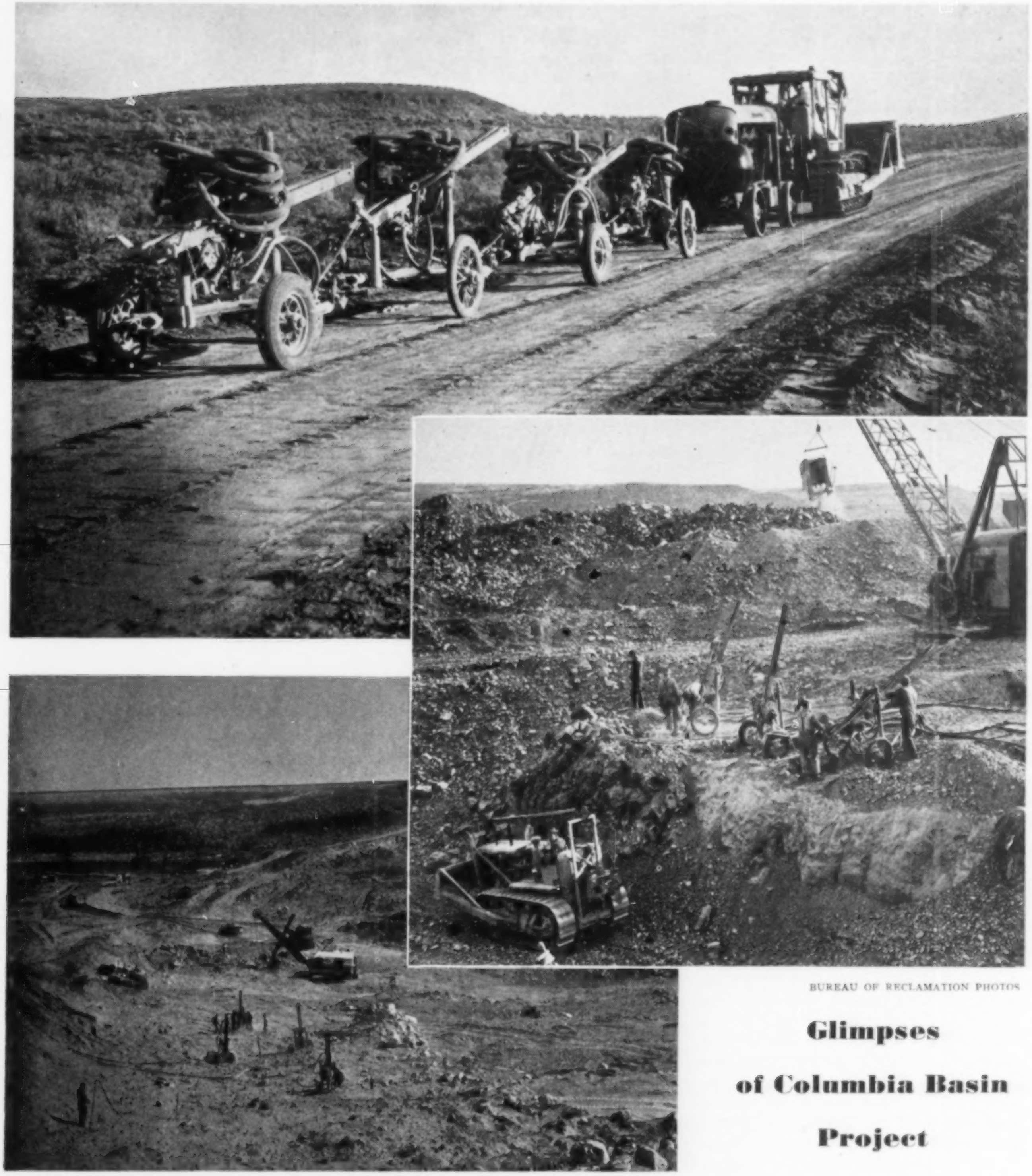
Another organization, the Columbia Delaware Bridge Company, was founded in 1839 and received charters from both New Jersey and Pennsylvania. Piers and abutments were built that year, but operations were suspended until 1869 when the structure was completed. The all-wood superstructure has four spans supported on three stone piers and the abutments and is 27 feet above the low-water mark. It is 796 feet long, 18 feet wide inside, and was built with a double driveway but no sidewalks. The bridge cost about $40,000, of which $37,500 was received in stock subscriptions. It was taken over by the Joint Commission on June 13, 1927, at an outlay of $50,000.

A second covered bridge over the Delaware was dismantled only last summer. It connected Lumberville, Bucks County, Pa., and Raven Rock, Hunterdon County, N. J., and is being replaced by a steel suspension bridge which will, however, be only wide enough for foot traffic. The original structure, opened in 1835, was about 750 feet long and consisted of four spans across the river and one over the Lehigh-Delaware Canal, which follows the stream on the Pennsylvania side. It had a double driveway and footwalks, and was built principally of hemlock, with oak dowels and flooring. Solon Chapin and Anthony Fry erected it for the Lumberville Delaware Bridge Company under an $18,000 contract. The river span nearest the Pennsylvania shore was destroyed by a flood in 1903 and supplanted by a steel structure. A police officer who has been on duty at the bridge for many years recalls that the toll for carriages was five cents per horse, that pedestrians paid two cents, and that the charge for a wheelbarrow was one cent. In 1857, the company's charter was amended to establish free passage for persons going to or from church. The structure was declared unsafe for vehicular traffic in 1944.

The bridge between Easton to Phillipsburg seems to have been especially well built, for it was the only one on the Delaware that survived the flood of 1841 unscathed. It was erected under the direction of Cyrus Palmer of Newburyport, Mass., a self-taught architect who had constructed a 2362-foot bridge at Piscatauqua, N. Y. The Easton crossing was badly needed, as travel through that point to the westward was heavy. The land on which Easton stands includes in part a tract of 1000 acres that was drawn in a lottery in 1735 by Thomas Penn, who was living in England. The settlement established there was first known as Forks of the Delaware, but Penn requested that it be renamed Easton, and this was done in 1751. Penn had just married a daughter of Lord Pomfret, whose country home in Northamptonshire was called Easton-Neston.

A ferry across the river at Easton was established by David Martin of Trenton, N. J., in 1741 under authority from King George II. The landing on the Pennsylvania shore was at the foot of the present Ferry Street, and from it a road was built along the tributary Lehigh River to the Moravian settlement at Bethlehem, 10 miles westward. Charters for the construction of a bridge were issued by both Pennsylvania and New Jersey in 1795. The bridge company lacked the necessary funds to proceed, however, and supplemental charters in 1802 extended for seven years the time allowed for completion. To assist the enterprise, Pennsylvania authorized a lottery in 1798 to raise $12,500 and loaned $10,000 in 1806 to put a roof on the nearly finished structure. The operating company owed $19,654.57 when the bridge went into service, but tolls paid off the debt in six years. In 1845, the Pennsylvania legislature reduced tolls and, in 1856, passage on foot was made free. The structure had three spans, 550 feet long and 34 feet wide. In 1885 street car tracks were laid across the bridge, which was one of the best paying across the Delaware. In 1895 it was replaced by the present steel cantilever structure.

Although the covered bridge has almost disappeared from the Delaware, the idea of charging tolls ushered in by it has persisted and even made headway in recent years. There are now four toll crossings over the stream, including one at Easton erected just before World War II above the site of the old covered way. For that matter, the American Road Builders' Association reports that there are 240 toll bridges in the nation, in addition to 25 toll highways, six tunnels, and 561 ferries. The traveling public pays around $100,000,000 annually for the use of these facilities.



BUREAU OF RECLAMATION PHOTOS

Glimpses of Columbia Basin Project

WAGON DRILLS ON MARCH AND AT WORK

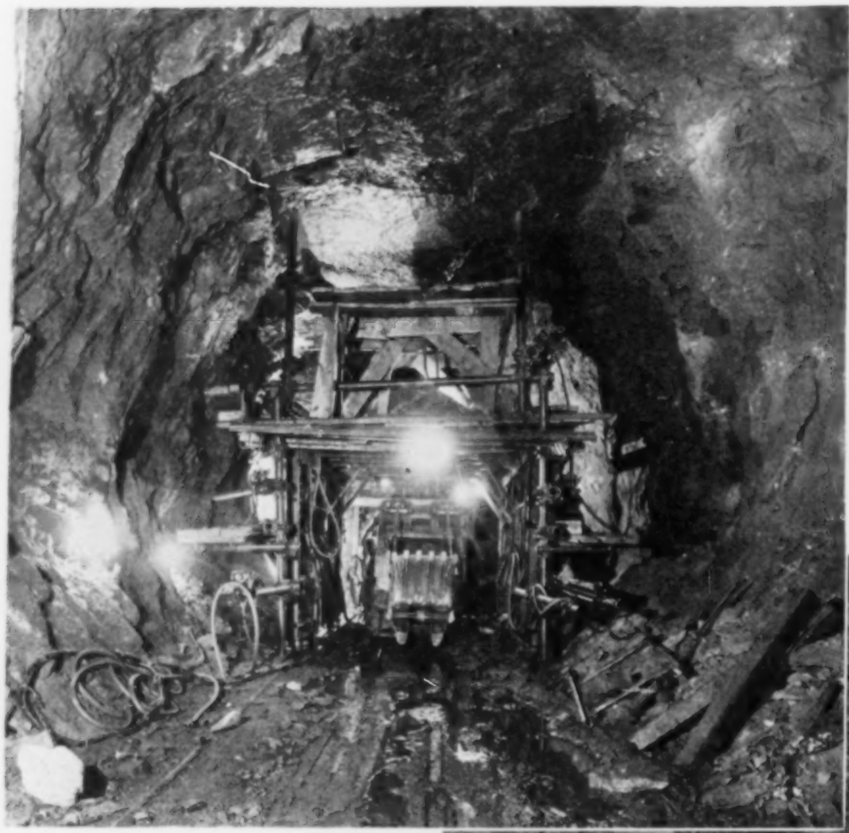
Work is underway on various phases of the U. S. Bureau of Reclamation's scheme for elevating water impounded by Grand Coulee Dam and distributing it to dry land in the Big Bend area of south-central Washington. Ultimately, one million acres will be irrigated. From Long Lake, a 27-mile-long equalizing reservoir to be formed by damming both ends of a coulee or gorge through which the Columbia River once ran, the water will flow through the Main Canal and thence by way of laterals to the farms. Forces of Morrison-Knudsen Company, Boise, Idaho, have been busy since last summer on the first 6.6-mile section of the Main Canal. It will be 50 feet wide at the bottom, 112 feet wide at the tops of the sloping embankments, and will carry a 24-foot depth of water at the rate of 9700 cubic feet per second. Excavating calls for the handling of two million cubic yards of rock and earth. At the top is pictured a tractor hauling a 315-cfm. Mobilair compressor and four Ingersoll-Rand FM-2 wagon drills to a drilling site. Three of the drills are shown in operation in the center view.

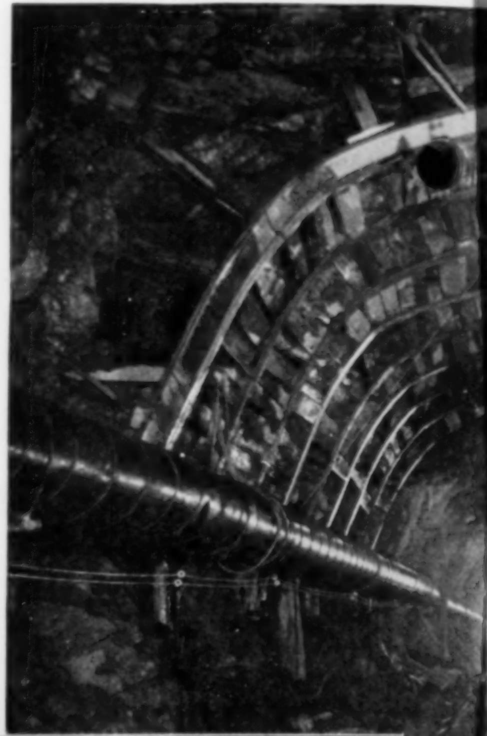
Potholes Dam is being built west of Warden, Wash., under a $9,359,011 contract awarded last November to C. F. Lytle of Sioux City, Iowa, Green Construction Company of Des Moines, Iowa, and Amis Construction Company of Oklahoma. The earth-fill structure will impound seepage and run-off water from about one-third of the irrigated area, making it available for distribution to other farm tracts. The dam will be 19,000 feet long and have a maximum height of 200 feet. It will form a reservoir with an area of 47 square miles and a capacity of 615,000 acre-feet. The view at the bottom shows the project at the beginning of operations, with a group of FM-2 wagon drills at work in the foreground and a power shovel in the background.

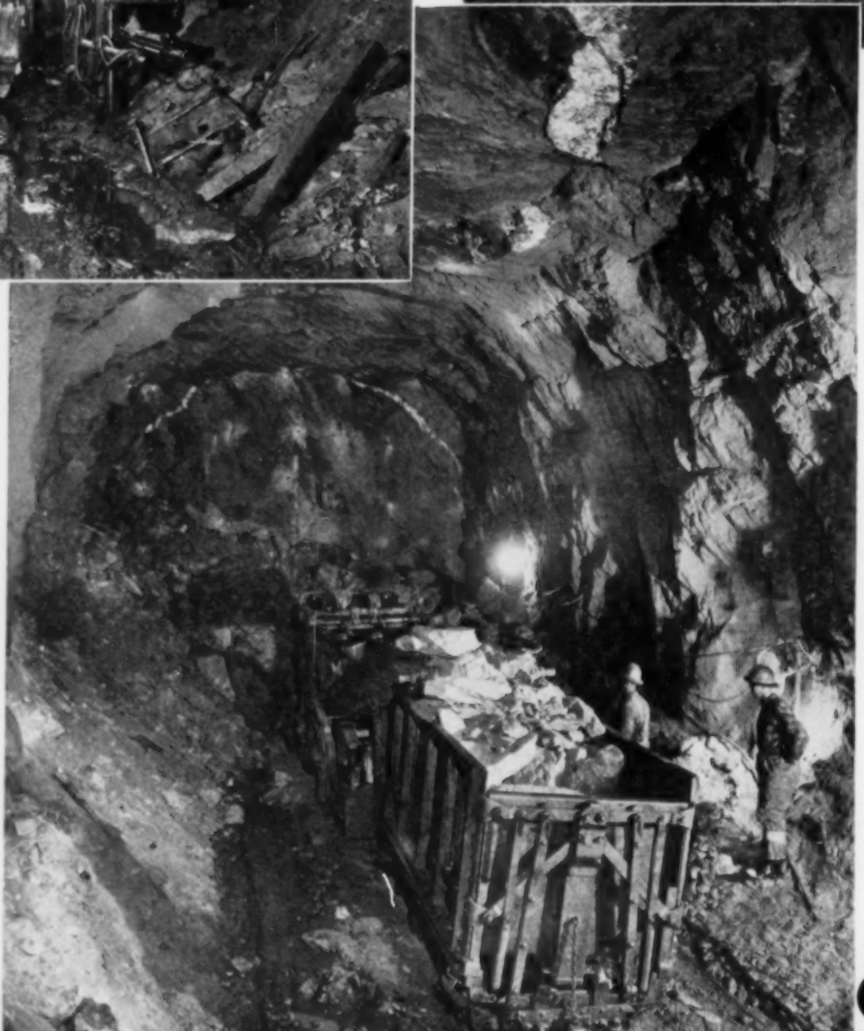
Under the Bay to Brooklyn

Part II

R. G. Skerrett

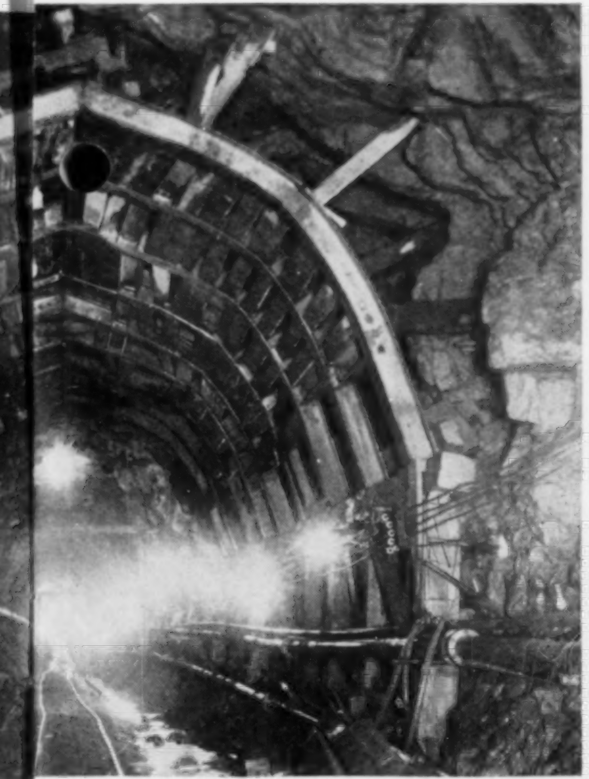






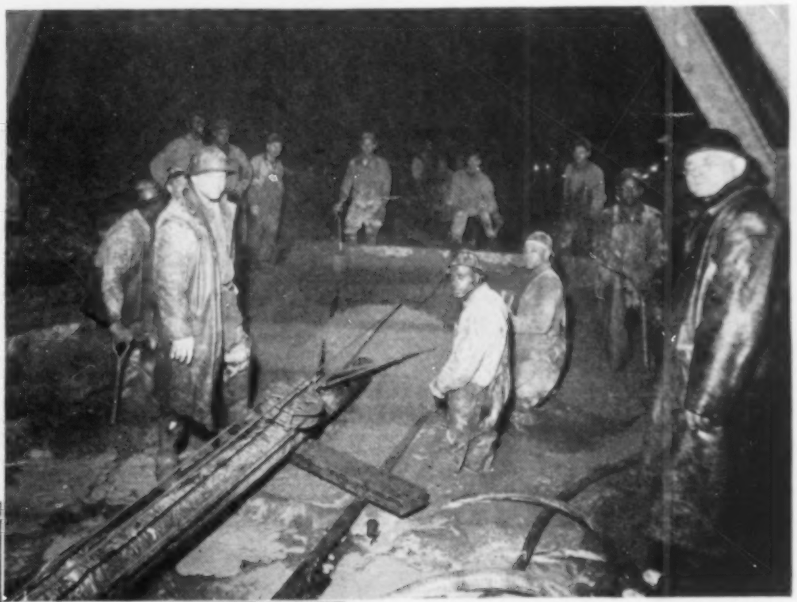
WORK on Contract No. 6, awarded to Mason & Hanger Company, Inc., was begun on October 20, 1941, at the single shaft in Battery Park. That shaft had been sunk by steel-sheeted construction in normal air and finished with heavy concrete walls. The interior space, 82 feet long and 30 feet wide, was divided into two working compartments by a central transverse bulkhead so that tunnel driving southward could proceed from either one independently of its neighbor. It took some months to assemble the equipment needed to carry the two tubes from the Battery to the proximity of Governors Island through rock beneath the East River on a gradient of −3.9 percent in the case of one and −3.5 percent in that of the other, gradually diminishing to −0.7 percent.

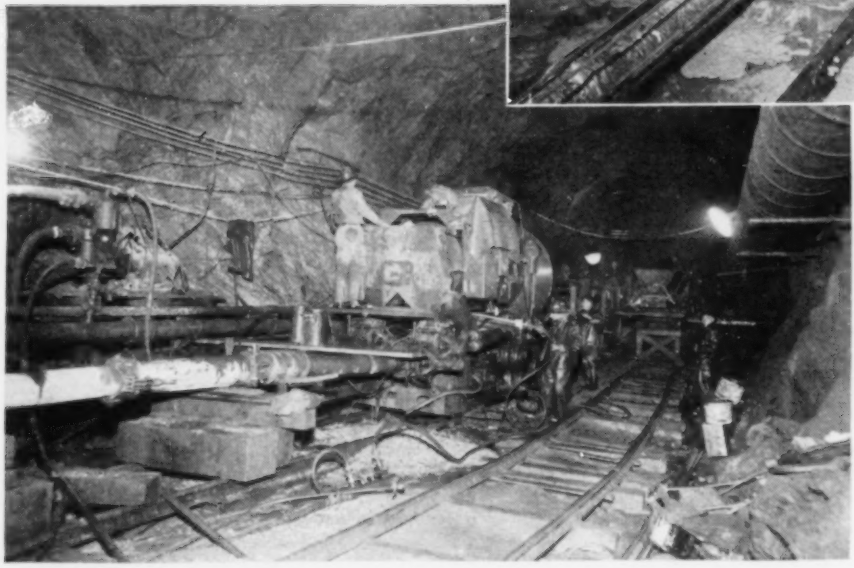
The power plant in Battery Park contains five compressors, three of which each have a capacity of 5600 cfm. and supply all the low-pressure air required for the operation of the shields. The others are high-pressure machines and furnish air for rock drills, Tugger hoists, drill sharpeners, grinders, and other tunneling equipment, including the ap-



SCENES IN MANHATTAN HEADINGS

Mason & Hanger Company is advancing the twin tubes from the Manhattan construction shaft to a point beyond the Governors Island ventilation shaft. Except for one stretch where there is a depression in the rock floor, tunneling has proceeded through material that is generally solid but weak and seamy in some places. Under those conditions, pilot headings were first driven and then enlarged At the extreme left is a 20x20-foot drift showing a drill carriage with a Conway mucking machine beneath it. The same drift is pictured below it but with a muck train at the working face. Unstable ground encountered in the roof was supported as illustrated at the left. After a bore had been enlarged to full section, a concrete invert was placed to provide a travelway for a shield to be used in erecting the cast-iron lining. The bottom view on this page shows a pump delivering concrete through a pipe line to pouring areas ahead. Concrete is seen issuing from the pipe in the picture just below.





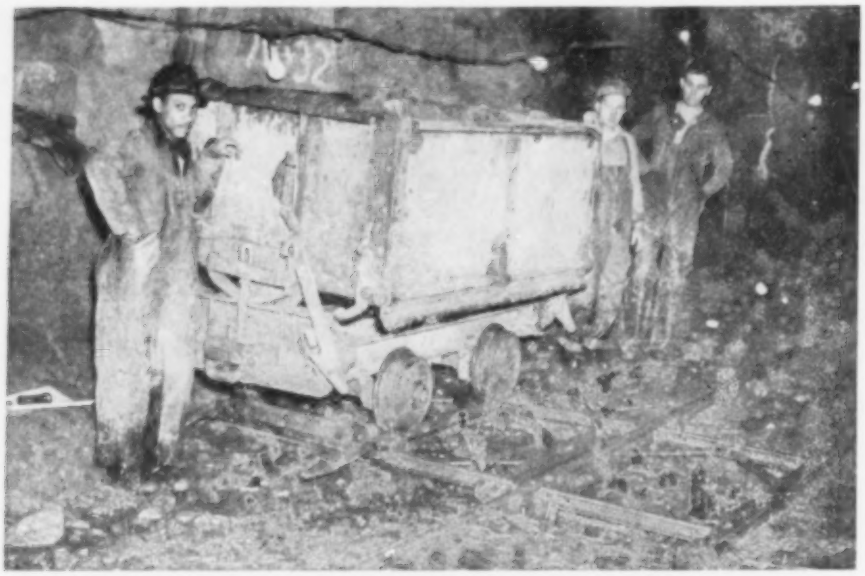
paratus used for tightening the bolts in assembling the liner rings and securing them to one another when developing a pressure that reaches a maximum of 30,000 psi.

Drilling started near the end of January, 1942, and the first shot was fired six days later. At that time the headings consisted of about 20x20-foot bottom drifts, to be enlarged later to full size for the cast-iron linings. The general scheme was to drive the rock headings in the east and west tubes the entire length specified in the original Contract No. 6, and then to enlarge the drifts to full section in convenient stages. In the mixed-face areas, it was recognized that drifts would have to be advanced under compressed air and that those sections that disclosed weakness on the part of the rock would have to be lined immediately with plates, steel ribs, and concrete.

In taking out the full section subsequently, the plan was to utilize a shield at each heading. Later, the contractor decided to use shields not only for the short stretches to be driven under air pressure but likewise in erecting the light cast-iron lining throughout the full rock sections. This was counted upon to facilitate the handling and setting up of the successive rings during the concluding stages of the tunneling operations.

The headings in the east and west tubes went forward at about the same rate, except when rock conditions were such as to slow up one or the other. That was the case towards the end of March in 1942 when the two 20x20-foot pioneer bottom drifts neared the valley in the rock surface close to the Battery Park bulkhead line. The east tunnel was the first to reach that depression, and preparations were made to start work under air when test holes indicated soft material a short distance ahead of that drift.

A concrete bulkhead, with a 10-foot-diameter air lock for materials and a 6.5-foot man lock, was constructed rearward of the troublesome area. It took the contractor April and May to clear the gap in the east tube and May and June in the west tube—actually two and a half months of difficult and dangerous work. Pilot-tunnel driving in both went ahead until interrupted by the war from January, 1943, until November, 1945. Before that halt occurred, Mason & Hanger was given the job of excavating the 400 feet of tunnel extension at the southern end of the original Contract No. 6 because the company had on hand the necessary steel and facilities to continue operations. That ended the first construction stage of the tubes advancing from the Battery.



CAR SHIFTER

This simple, portable device was used for switching empty cars from the rear to the head of a train as loading progressed at the face. The empty was pushed on or off the main track on a carriage riding on the transverse rails.

When the project was brought to a stop in December, 1942, the headings had been driven 2800 feet southward from the Manhattan shaft, the equipment was withdrawn, and the tunnel, just as it stood, was allowed to flood with seepage. It took about two weeks to unwater the workings before rock excavating could be resumed in December of 1945. It was concluded in March, 1946, at a point approximately 80 feet beyond the center line of the shaft for the contemplated ventilation building adjacent to Governors Island.

The second stage involved the enlargement of the pioneer tunnels, proceeding northward from Governors Island toward the construction shaft at the Manhattan end. This work was interrupted about May 1, 1946, when the contractor turned to the third stage—mucking the invert and placing the concrete cradle upon which the shield was to travel from Manhattan back to the vicinity of Governors Island. For these operations Mason & Hanger used Jackhamers, paving breakers, air-driven centrifugal-type sump pumps, Tugger hoists, and concrete vibrators operated by Multivane air motors. The vibrators compacted the concrete while being placed in the invert and also served elsewhere in the tubes where concrete had to be poured. The Tuggers pulled the steel screeds that formed the curved surface of the invert sections, and a number of these handy units were brought into play variously for hoisting, drawing, and for the purpose of temporarily maintaining tension. The sump pumps disposed of leakage that might otherwise have accumulated and flooded tunnel floors.

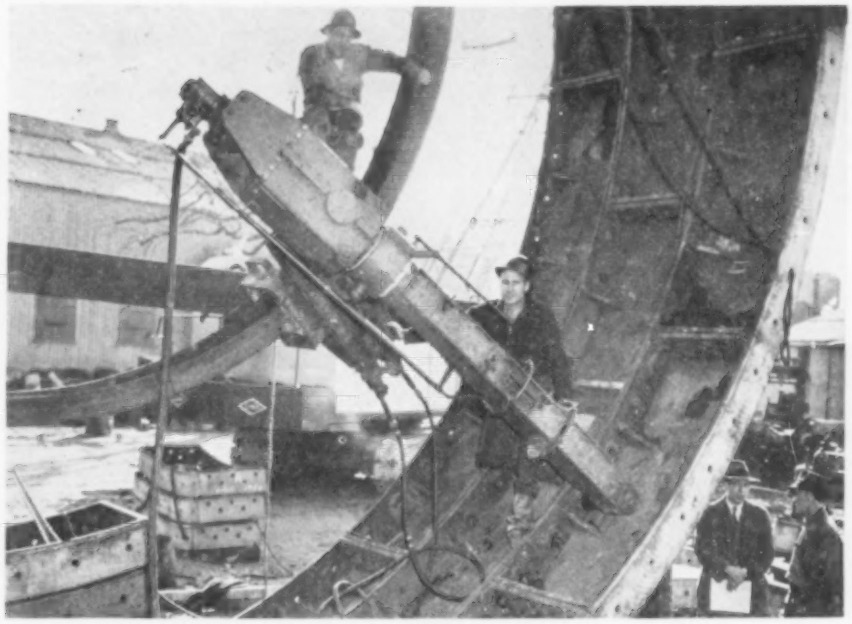
The fourth stage entailed resumption of tunnel enlargement from a point approximately 350 feet north of the site of the Governors Island shaft to about 300 feet south of the Battery pier line. Contract No. 7 for the sinking of that shaft had not then been awarded. As explained by Howard L. King, chief engineer of the Mason & Hanger Company: "The fifth stage has called for reversing the direction of advance by driving the shields southward from the construction shaft and back to the Governors Island shaft, during which the cast-iron tunnel lining is being erected in the tails of the shields as the latter shove themselves onward. This operation has required work under compressed air while passing through the area where the top of the rock overhead is low." The sixth and final stage will involve placing the concrete lining inside the cast-iron rings. This work will not be started until the last of the ring sections has been erected, tightened, and calked.

During the pioneer drifting operations in both tubes southward from the Battery construction shaft, the headings, as already mentioned, were 20x20 feet until after the "gorge" in the rock had been passed. Then they were increased to 25x25 feet, and so continued to the Governors Island end of the contract. The rounds were drilled horizontally, and the rock was blasted by delay firing. On the reverse journey, northward from Governors Island, enlargement was done by horizontal drilling. This was carried forward a distance of 150 feet in each tube to permit the use thereafter of larger drilling jumbos mounting nine drifter drills. Pioneer drifts were advanced by means of smaller drill carriages equipped with fewer machines. Final excavating to the required 31-foot circular section has been essentially a trimming job.

At the start of the enlargement work the contractor encountered bad, seamy rock in the vicinity of Governors Island, and excavating for a considerable stretch

STEEL-CLAD AIR LINE

To permit construction of the ventilation building at a point approximately midway of the tunnel, the Grow Construction Company first had to build an island and then sink a shaft by means of a caisson. The latter is pictured on our front cover. Working space was at a premium on the man-made island, so electric power, compressed air, and other utilities needed were supplied from equipment on a barge moored nearby. The air delivery line not only had to withstand the internal pressure but also the movement of the barge as it rose and fell with the tides and shifted with the currents. To meet these conditions, Penflex metal hose was used. The picture shows a workman attaching a 4-inch flexible, interlocked steel line of this type to an air receiver on the island.



BOLT-TIGHTENING MECHANISM

A demonstration set-up of an assembly that was devised to use air power to tighten bolts holding the cast-iron lining segments together and thus save much of the time and muscular effort expended when this work is done largely by hand. Nuts are first run on the bolts snugly with I-R 44E track wrenches and are then tightened to a uniform tension of 30,000 psi. with this unit. The tightener arm is mounted on a circular I-beam track, along which it is moved by two Ingersoll-Rand close-quarter drills to contact any bolt in the liner ring. The final force is then applied with a Multivane drill.

necessitated the use of steel with supports. Thereafter, the rock lost its "blocky" nature and improved with progress northward. A final barrier of rock 20-odd feet through will remain in each tube between the tunnel sections driven by Mason & Hanger and those of George H. Flinn Corporation approaching from the south. Those walls will remain as a safety measure until after shaft sinking close to Governors Island has been completed by the Grow Construction Company.

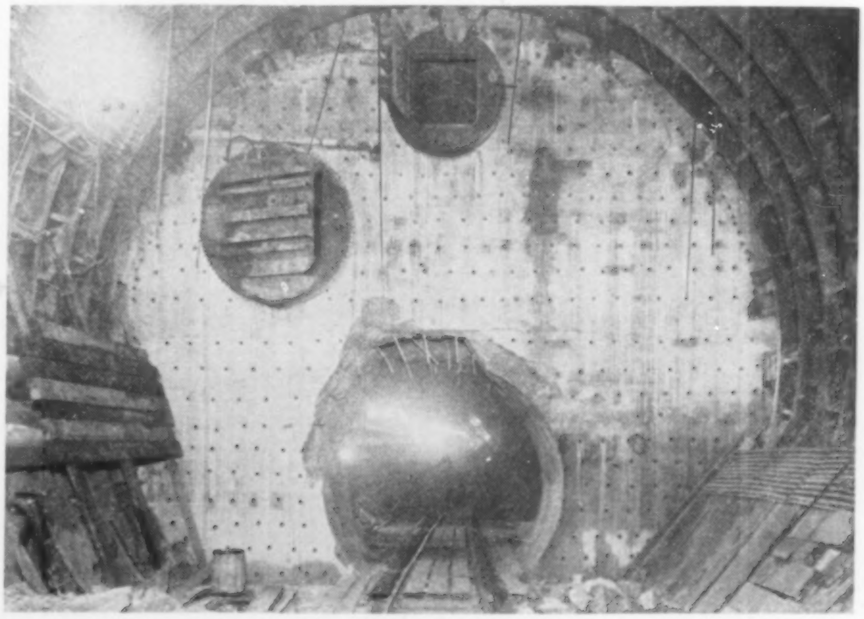
At the heading in one of the two tubes advancing from Brooklyn, a single hole was driven on the tunnel axis through the 20-foot barrier to verify its closeness to the prescribed line. This exploratory drilling revealed that the axis of the tube in question is within ¼ inch true to grade and departs only ⅛ inch from the prescribed line for the axis. Such is the precision of the work now done by the tunnel engineer. The hole was subsequently sealed.

Shaft sinking under Contract No. 7 consists primarily of lowering an open caisson on a temporary island formed of sand and clay dumped on the river bottom and having a depth of 50-odd feet—just enough to bring the top clear of the water at mean high tide. The "sand-island" method, as this procedure is generally known, involves the use in this case of a steel caisson formed of successive, riveted sections. These are set one atop the other as the caisson sinks and until its cutting edge rests on bedrock. In plan, the outside dimensions of the structure are 111 feet 1¾ inches by 51 feet 1¾ inches. The interior is subdivided into three rectangular shafts with intervals between of 4 feet ¾ inch. The central compartment is 23 feet wide and the flanking ones are each 35 feet 5¼ inches in width. The exterior shaft walls parallel the outer or main skin of the caisson with an interval of 6 feet 6⅞ inches on the four sides.

As each lift is added, the separating spaces are filled with concrete to form structural walls, and the caisson is further provided with horizontal wall trusses and both outside and inside skin plating. From the cutting edge to the top of the concrete walls, the structure measures 74 feet 8 inches, with the outer skin plating extending 11 feet 4 inches above that height. Upward from a point approximately 51 feet above the cutting edge the outer concrete walls will diminish in thickness—will be 18 inches less than they are below that level.

The caisson is being sunk by dredging in the open wells or shafts formed by the concrete walls; and compressed air may have to be used in sealing the cutting edge into the rock at a depth of 77 feet below mean high water. The latter section was erected on the island, which had been built up progressively of sand, clay, and riprap; and sinking started when the walls were partly erected and concreted. After the caisson has been tied to the rock, the bottom section of the ventilation shaft will be excavated and carried down to a point 139 feet below mean high water. At that elevation the roadway of the tunnel will be 115 feet below mean high water.

The ventilation building which will surmount the shaft is to be an octagonal structure supported by the shaft walls and by eight steel cylinders, 5 feet 5 inches in diameter, sunk to rock outside the shaft. It will be surrounded by a



A BULKHEAD FULL OF HOLES

This 10-foot-thick concrete barrier fitted with muck, man, and emergency locks was used when the heading had to be put under compressed air to drive through the "gorge" in the rock floor. After the cast-iron lining had been erected throughout that stretch, the bulkhead was no longer needed. To remove it, it was drilled full of holes as shown here and then dynamited.

dock-like fender that will rest on the river bed and rise above the surface of the water. The rectangular caisson straddles the two tunnel tubes with its longer dimension transverse to them, and the axes of the tubes will be not more than 45 feet apart.

In principle, the ventilating system will be similar to that developed for the Holland Tunnel and used in the Lincoln and the Queens-Midtown tunnels, with such modifications as experience has shown to be desirable and needful to meet the requirements of New York City's latest underwater highways. Fresh air will be distributed to the driveway area of each tube just above curb level from flues spaced at suitable intervals on each side. The flues, in turn, will connect with a capacious fresh-air duct that underruns the roadway. Vitiated air will be drawn up through ports in the ceiling and transmitted to the exhaust stacks of the ventilation buildings. Twenty seven blower fans and 26 exhaust fans will give the Brooklyn-Battery Tunnel a normal maximum fresh-air supply of about 4,200,000 cfm., or 42 complete air changes each hour. According to the plans there will be seven blowers and eight exhaust fans in Manhattan, twelve blowers and twelve exhaust fans in the Governors Island building, and eight blowers and six exhaust fans in Brooklyn.

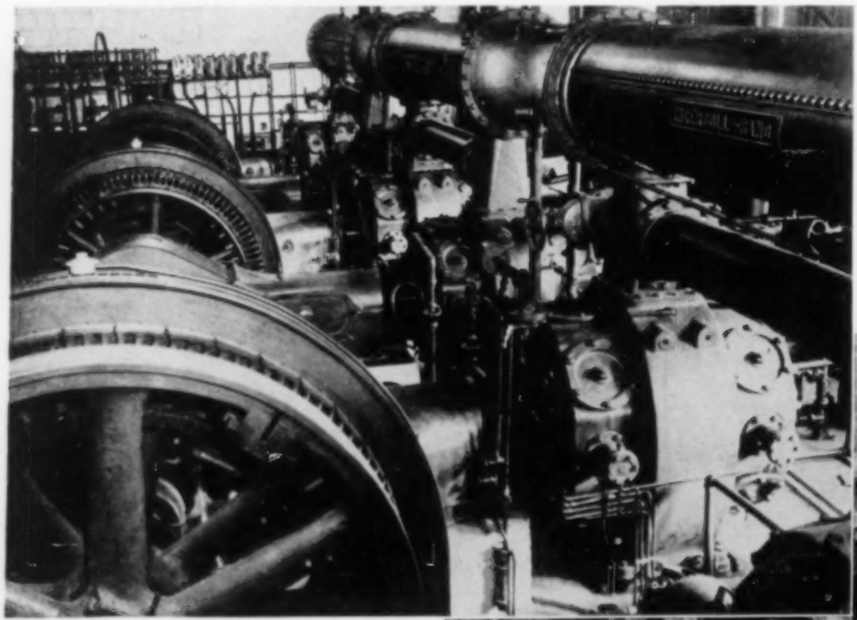
The tunnel roadway in each tube will have a width of 21 feet 4 inches between curbs, providing ample room for two lines of traffic moving speedily. The ceiling will be 13 feet 6 inches above floor level and will afford clearance for the tallest of heavy vehicles. One of the interesting features of the new tunnel will be the substitution of fluorescent tubular lights for the incandescent lamps heretofore employed. It may be recalled that fluorescent lighting, which was studied when the Queens-Midtown Tunnel was under construction, was abandoned then primarily because it had had but limited general service. With suitable modifications, this system of illumination has proved itself highly desirable and more economical, besides being better adapted to the needs of such a passageway where it is essential to eliminate brightness contrasts, which are said to be the principal cause of eye fatigue and strain experienced by drivers when going from sunshine into the relatively reduced light of a tunnel.

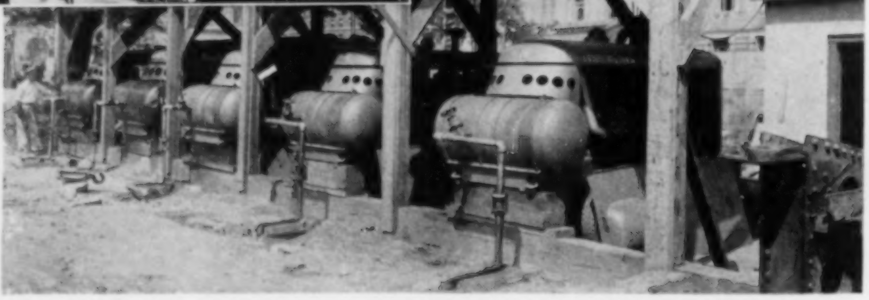
The most active above-ground evidences of the construction of the Brooklyn-Battery twin tubes are to be found in lower Manhattan at or adjacent to the portal area, where many old buildings have been razed preparatory to starting the entrance and exit connections with street-level traffic and the important West Side Express Highway. This cut-and-cover work extends from the Battery Park shaft northward to the portals just mentioned, and is being carried out jointly under associated contracts by the Gull Contracting Company, Inc., and L. G. DeFelice & Son, Inc. Powerful portable compressors are furnishing motive air for rock drills and other pneumatic excavating equipment used in clearing away the overlying ground, manifestly laboriously reclaimed from the river 100 or more years ago, and in removing part of a rocky section of the geological foundation of Manhattan Island.

Up to date, the cost of the tunneling operations totals $30,000,000, which covers work done and contracts now going forward. This outlay, of course, will be higher when all the contracts for this great engineering undertaking have been awarded and the job is completed in 1949. In fact, it has been estimated that the appropriation of $57,000,000 for the "plaza to plaza construction of the river crossing" will be exceeded by $14,000,000 because of the increasing cost of labor and materials. While Brooklyn and Manhattan will be the immediate gainers, tributary regions also will benefit by the new means of motor-traffic relief. Furthermore, sections of both boroughs situated close to the portals will find themselves profiting in one way or another, as have property owners, business enterprises, workers, and many others located in the vicinity of the approaches to the three earlier vehicular tunnels.

The Brooklyn-Battery Tunnel is being built under the direction of the Triborough Bridge and Tunnel Authority, of which Robert Moses is chairman, with George V. McLaughlin and Charles G. Meyer vice-chairmen. George E. Spargo is general manager and secretary, and Ralph Smillie is chief engineer.

(Conclusion)

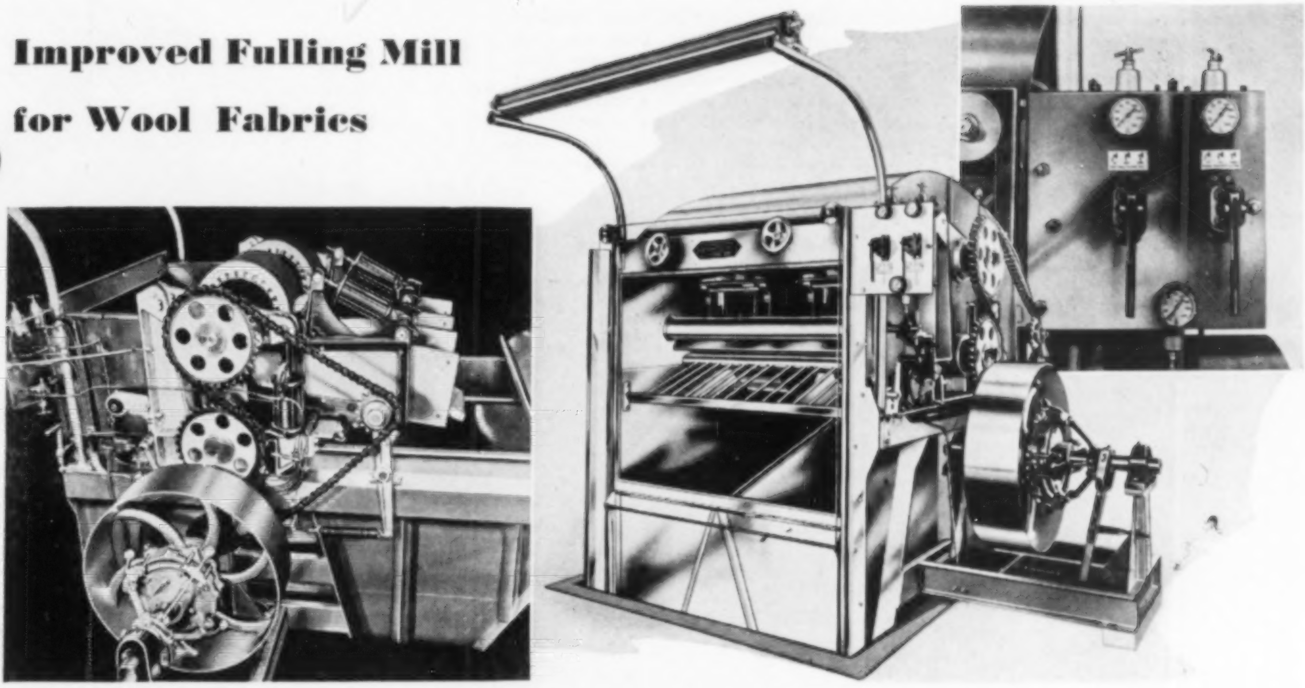




AIR COMPRESSORS

Above are shown three electrically driven compressors, each with a capacity of 5600 cfm., that supplied low-pressure air for the Mason & Hanger operations. At the right are pictured five portable units used by L. G. De Felice & Son, Inc., in excavating for the Manhattan approach to the tunnel.

Improved Fulling Mill for Wool Fabrics



"AIR EXPRESS" FULLING MILL

In the center is an over-all view of a mill, with the doors open to expose the packing box at the top, rolls beneath it, and tubs below. The pneumatic cylinders that apply pressure in the packing box are shown at the top of the picture at the left. One of the two cylinders that control the pressure on the main rolls is within the triangle described by the drive chain. An instrument panel is illustrated at the right. The working pressures can be fixed by setting the dial gauges as desired. The levers control the operations of the packing box and of the main rolls. When the main-roll lever is down, as shown, the rolls operate under the preset pressure. Placing it in the horizontal position stops the mill, and raising it until it is vertical elevates the top roll

A NEWLY woven piece of woolen cloth doesn't look or feel much like the finished article in the suit you are wearing. When it comes from the loom it has the appearance and texture of burlap, being loose, flabby, and rather harsh to the touch. If you have ever seen homespun you will have noticed that it lacks the smooth surface and compact weave of the textile-mill product. That is because it has not been "fulled" at all, or to such a slight extent that no real felting has taken place.

To transform cloth as it comes from the loom into material that will look well, wear well, and hold its shape when fashioned into clothing, the textile plant gives it extensive treatment in what is known as a fulling mill. The process softens the fibers and causes them to shrink together to form a fabric with a good body. The extreme example of fulling is seen in a felt hat, where the wool or fur fibers are intermingled in a dense material that retains no sign of individual fibers. Cloth fulling is, of course, not carried that far, and the extent varies with the nature of the textile and the finish it is to receive.

In the fulling operation, soap or acid is applied to the material to make it mildly alkaline or acid, as may be desired, and it is then subjected to pressure of two kinds by repetitive treatments. Numerous pieces of cloth are placed in a fulling mill and first run through compressing rolls. Next they are passed into a packing box, where they are crimped and put under pressure by the horizontal movement of multiple vertical fingers. Finally, they go to a tub in the base of the machine and are then directed back to the rolls. This cycle is repeated over and over until the cloth has been "worked" to the desired extent. The pressure and friction induce heat, which is an essential factor in the fulling process. Other operations follow fulling, but the latter is considered the most important one in the finishing treatment.

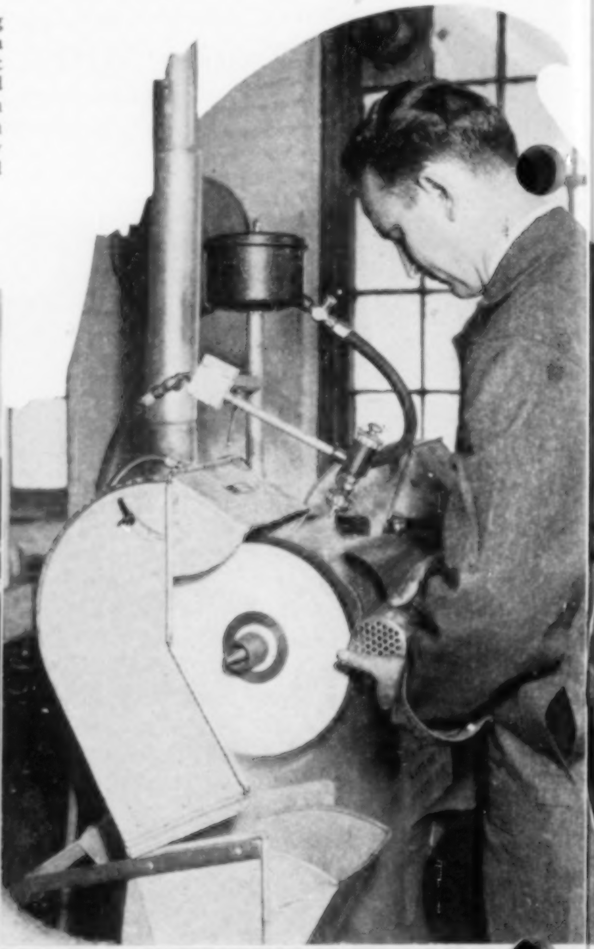
The Rodney Hunt Machine Company of Orange, Mass., which has been making fulling mills for more than 100 years, has recently introduced a new, stainless-steel, pneumatically controlled model that is claimed to be a revolutionary advance in equipment of this type. Traditionally, pressure has been applied to rolls and packing boxes by springs or by weighted levers that have to be loaded and unloaded by hand and that are incapable of being accurately adjusted. In the case of the new unit, pneumatic cylinders have been substituted for these unwieldy mechanisms.

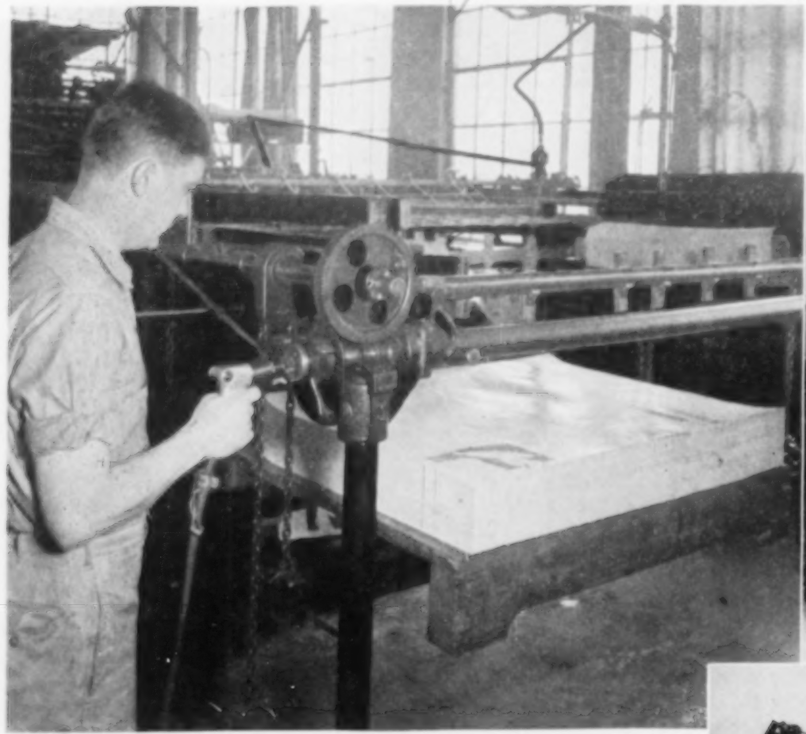
With air cylinders it is possible to regulate operating pressures merely by changing the setting of a dial gauge on the instrument panel. Once the most satisfactory pressures for a given kind of material have been determined, they can be recorded and duplicated whenever similar runs are being made. Precisely the same pressures can be exerted from hour to hour and day to day, insuring consistent results. This close control has never been possible before.

In addition to the pneumatic cylinders, air controls are applied to the "knock-off" or stopping mechanism. When a mill stops, pressure on the main rolls and packing box is automatically released. When starting, pressure is not applied until the machine is up to running speed, and this results in a material saving in power. Once in operation, the pressures for which the controls have been set are automatically applied.

The manufacturer stresses the pneumatic feature of the new mill to the extent of calling it the "Air Express." It is advertised to be so superior to previously available machines that one new unit will do the work of two or three older ones. The adoption of pneumatic controls for this mill is in line with a movement by the Rodney Hunt organization to apply air power to all of its textile machinery. On this point, B. M. Jones, manager of the firm's textile-machinery division, says: "We have been one of the pioneers on textile machinery and, at present, almost all of our machines of various types use pneumatic cylinders and controls in one form or another. We consider this a tremendous advance in textile machinery designing."

BUFFING compositions have conventionally been applied to a buffing wheel by holding a bar or cake of the material against it. Now the Lea Manufacturing Company of Waterbury, Conn., has improved upon that method by devising an applicator (right) that sprays an emulsion carried in a stream of compressed air. It is claimed that this insures a more uniform coating than was previously obtainable and cuts material consumption in half. In addition, the operator does not have to stop buffing periodically to replenish the wheel's supply. The spray is controlled by a foot-operated valve in the air line.





PRINTED sheets coming off the delivery end of a Miehle flat-bed cylinder press (above) are deposited on a wooden skid that is suspended by chains. As each sheet is delivered, the bar that appears to be slanting downward from the man's chin turns a worm and gear to lower the skid a minute fraction of an inch—the equivalent of the sheet's thickness. By the time the skid is full it has reached floor level. To raise a fresh skid to the proper height or to lower a partially filled one when a short run is being made, it was formerly necessary to crank the gear wheel by hand—an arduous and time-consuming task. In the plant where this magazine is printed the job has been taken over by a small Multivane pneumatic drill fitted with a screw-driver-like bit. The end of the bar bearing the worm is slotted to take this attachment, as shown here. With this tool the pressman runs an empty skid up or a partly loaded one down in a few seconds.

SPECIFICATIONS covering the construction of the Friant-Kern Canal in California call for overexcavating cuts in rock and backfilling with select, compacted earth. To effect tamping, K. D. Watson, general superintendent for Peter Kiewit Sons' Company, the contractor, designed the skid-mounted machine pictured at the right. It has a boom along which moves a pneumatic cylinder and piston with a 14x28-inch tamping pad on the end. Earth spread 2 feet thick is compacted to a 14-inch layer by 10,000-pound blows. Working on a slope, as shown, the machine tamps 300 feet of canal bank in seven hours. The rig is pulled along by a tractor.

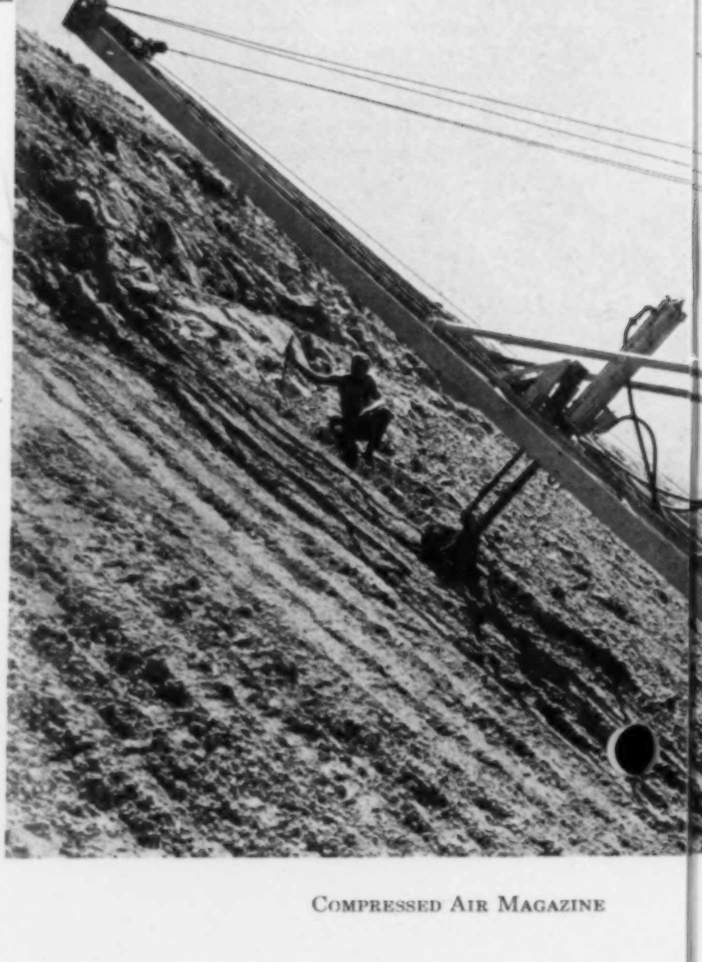
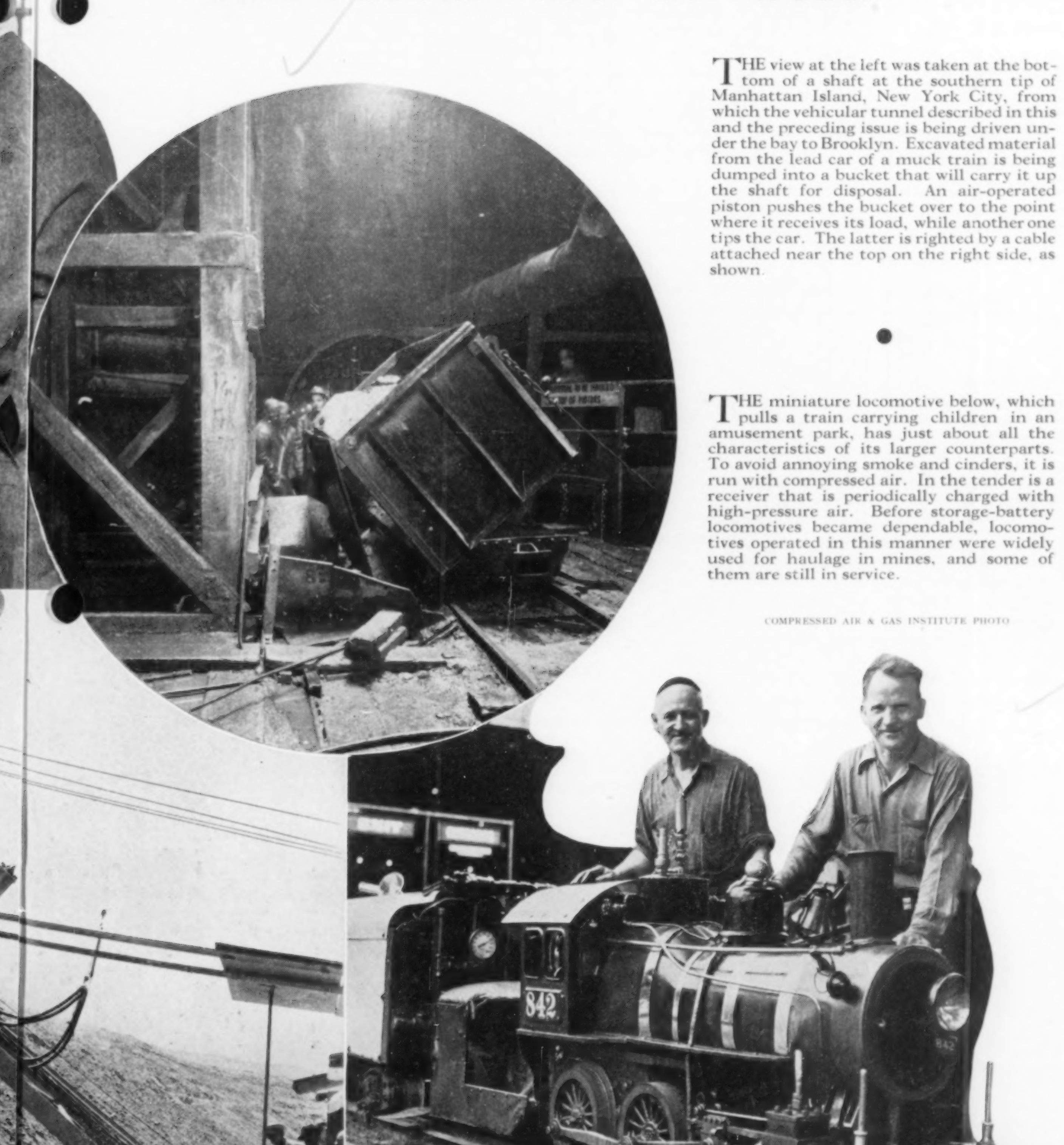


PHOTO COURTESY CONSTRUCTION METHODS

COMPRESSED AIR AT WORK



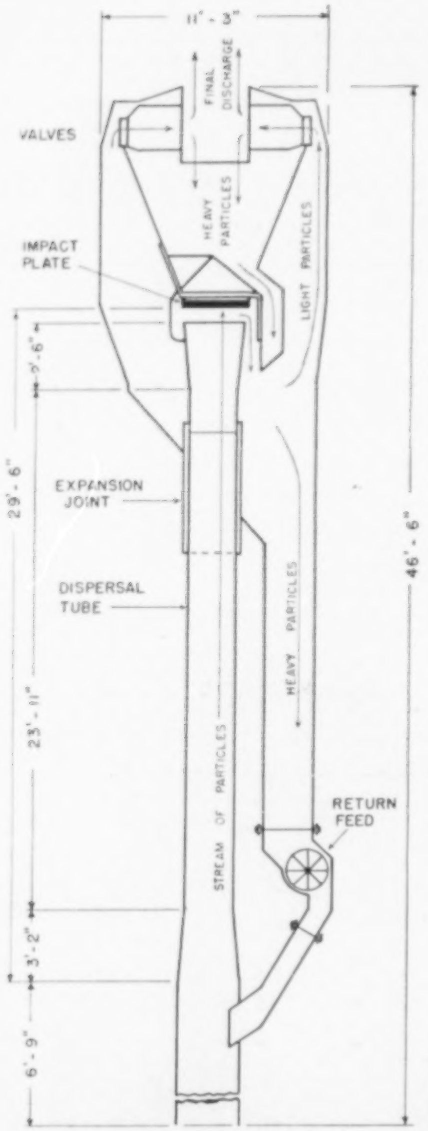
THE view at the left was taken at the bottom of a shaft at the southern tip of Manhattan Island, New York City, from which the vehicular tunnel described in this and the preceding issue is being driven under the bay to Brooklyn. Excavated material from the lead car of a muck train is being dumped into a bucket that will carry it up the shaft for disposal. An air-operated piston pushes the bucket over to the point where it receives its load, while another one tips the car. The latter is righted by a cable attached near the top on the right side, as shown.

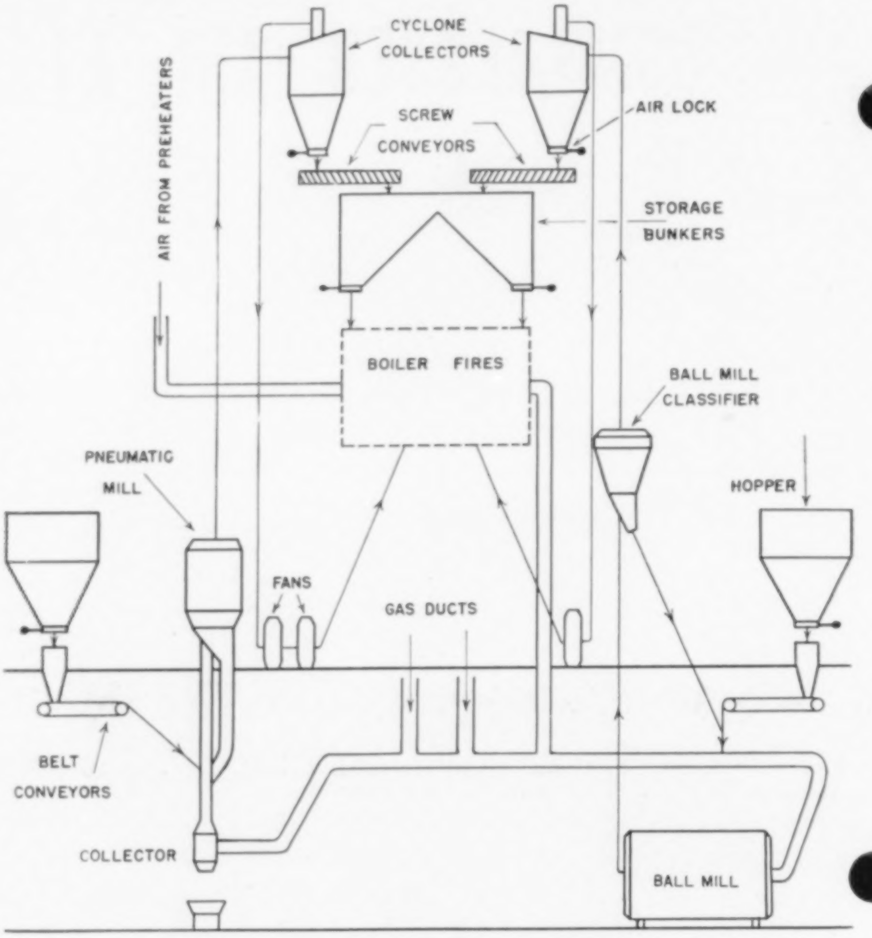
●

THE miniature locomotive below, which pulls a train carrying children in an amusement park, has just about all the characteristics of its larger counterparts. To avoid annoying smoke and cinders, it is run with compressed air. In the tender is a receiver that is periodically charged with high-pressure air. Before storage-battery locomotives became dependable, locomotives operated in this manner were widely used for haulage in mines, and some of them are still in service.

COMPRESSED AIR & GAS INSTITUTE PHOTO

Pneumatic Mill Grinds Coal in Russian Plant


11'-3"
FINAL DISCHARGE
VALVES
HEAVY PARTICLES
LIGHT PARTICLES
IMPACT PLATE
2'-6"
29'-6"
EXPANSION JOINT
46'-6"
DISPERSAL TUBE
HEAVY PARTICLES
23'-11"
STREAM OF PARTICLES
RETURN FEED
3'-2"
6'-9"


CYCLONE COLLECTORS
AIR FROM PREHEATERS
SCREW CONVEYORS
AIR LOCK
STORAGE BUNKERS
BOILER FIRES
BALL MILL CLASSIFIER
PNEUMATIC MILL
HOPPER
FANS
GAS DUCTS
BELT CONVEYORS
COLLECTOR
BALL MILL

PLANT LAYOUT AND MILL CROSS SECTION

Above is a schematic diagram of a boiler plant equipped with a pneumatic mill, which is located at the lower left. Fuel is fed to the mill from a hopper by a belt conveyor, and a standard-design cyclone collects the pulverized coal and passes it on to a screw conveyor through an air lock consisting of two rotary valves. The product is drawn from a storage bunker as needed to feed the boiler fires. At the left is a cross section of the grinding mill, showing how double separation of coarse and fine materials is effected.

COAL for boiler operation is being ground in Russia by a pneumatic mill that was developed there by the All-Union Thermo-Technical Institute. Designed by M. L. Kiselhof of the institute, the mill makes use of a stream of hot gases to entrain particles of coal and to eject them from a nozzle against an impact plate to effect their disintegration. The first full-sized unit of this type was put in operation in 1944. It has an hourly capacity of 27 tons of sized Lower Moscow coal having an average moisture content of 33 percent and a maximum size of ¾ inch. The mill operates in parallel with a ball mill of the same capacity to feed a 100-ton-per-hour Loeffler boiler.

Essential parts of the pneumatic mill are a collector for removing foreign matter, a dispersal tube, a grinding chamber, a separator, and a return feed. Fuel introduced into the dispersal tube is exposed to hot gases which carry the coal upward through the tube and allow heavier, extraneous material to fall into the collector at the bottom. The particles of fuel emerge from the dispersal tube and strike the impact plate in the grinding chamber. After disintegration they undergo double separation. The first takes place in the grinding chamber where the coarse fractions fall from the gas stream and are returned to the bottom inlet of the dispersal tube, while the second is effected in the conical space above the impact plate. Insufficiently ground pieces are rejected—discharged into the first separator by three nipples closed by flap valves. The second separator is equipped with adjustable inlet vanes which permit the coal to be ground to any desired fineness. The final product passes from the second separator to the cyclone and, finally, to a storage bunker.

In order to insure entrainment of the coarse particles of coal and at the same time allow the separation of foreign material from the fuel, the bottom section of the dispersal tube was designed for a gas velocity of 154 feet per second, as compared with an over-all tube velocity of 213 feet per second. In the upper part of the tube the velocity of the gas is decreased to 98 feet per second by a diffusor. The total length of the dispersal tube is 17 feet 3 inches. It may be extended up to 30 feet, if desired, but that would result in a 15 percent increase in resistance to gas flow. As the lower section of the tube and the separator are both bolted to the boiler structure, the tube is provided with an expansion joint. The impact plate is made of armor plate 2⅜ inches thick and is separated from the top of the diffusor by a distance equal to 0.4 times the diameter of the diffusor.

Two suction fans give the gas the required velocity. Designed to deliver 48,000 cfm. at 158°F. against a static head of 73 inches water gauge, they are driven by motors of 400 and 455 hp., respectively. The gas-air mixture used in the dispersal tube as the drying and entraining medium has an initial temperature of 1200° and reduces the moisture content of the coal from 35 to 15 percent.

Output of the mill is determined by three factors—the rate and size of the fuel feed, the amount of gases passed through the circuit, and the degree of fineness of the end product. For a given rate of gas flow, production decreases as the size of the raw fuel fed to it increases. With the same rate of gas flow, and feeding coal of constant size, output rises sharply with increasing coarseness of the final product until a certain maximum output is reached. By appropriate adjustment of the inlet vanes of the separator, practically any desired fineness may be obtained. For instance, a vane angle of 45° results in a residue of 10 to 12 percent on a No. 170 A.S.T.M. sieve, while the residue with an angle of from 75 to 90° amounts to approximately 35 percent. Very fine pulverization with a residue of less than 10 percent can be obtained by setting the vanes at an angle of less than 45°. The wide variation in gas velocity possible by changing the position of the separator vanes has but an insignificant effect on the fineness of the end product.

Drying and grinding of the fuel are simultaneous processes in the pneumatic mill, and for a given initial moisture content the drying action is dependent upon the fuel-to-gas ratio as well as the initial gas temperature. Tests show that with an initial moisture content of 30.9 percent, a fuel-to-gas ratio of 0.4, and an inlet temperature of 900°F., the moisture content of the final product will be 13.5 percent. By raising the inlet temperature to about 1000°, and by lowering the fuel-to-gas ratio to 0.206, a reduction in moisture content to 2.5 per cent was made possible by the use of coal having an initial moisture content of 24 percent.

Wear on the disposal tube was found to be approximately 0.04 to 0.06 inch of wall thickness for each 100 hours of operation, and the impact plate showed a loss in thickness of 0.05 inch in the same length of time. In the case of the mill as a whole it was 0.2 pound of metal per ton of coal ground, which compares favorably with a figure of 0.66 pound per ton for ball mills.

The article on which this material is based was written by M. L. Kiselhof, the designer of the pneumatic mill. It was published in a Russian technical journal and appeared in abstract form in this country in the "Engineers' Digest."

Pressure Gasometer Aids in Industrial Health Studies

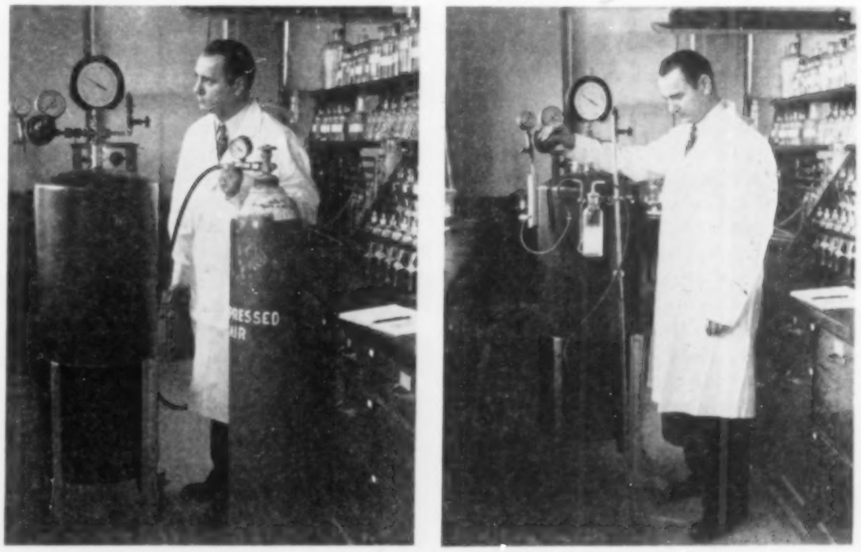
AN UNUSUAL application of compressed air has been found in the development of a pressure gasometer by the Bureau of Industrial Hygiene of the Detroit Department of Health. Before gas and vapor measuring devices can be used satisfactorily for the examination of workroom air, each instrument must be checked with a known concentration of the vapor to be determined. This is called "calibrating" the instrument and enables the bureau's engineers and chemists to make accurate determinations when estimating the amount of toxic vapors present in industrial atmospheres.

This type of calibration has always entailed considerable difficulties chiefly because it is not easy to keep constant amounts of solvent evaporating without gross fluctuations. Moreover an air chamber large enough to serve as an experimental room is not within the reach of most laboratories. The pressure gasometer, however, has solved the problem of constant amounts of vapor-air mixtures. The instrument itself consists of a sturdily constructed steel chamber (air-compressor tank) with a capacity of about 4.7 cubic feet. It is provided with an inlet valve for solvent and air, a pressure gauge, a needle valve, and a safety valve.

Setting up and operating the apparatus is comparatively simple. The gasometer is first brought under reduced pressure by evacuating it. Then a weighed amount of the solvent whose vapor is to be tested is placed in a small flask and attached to the inlet valve. The latter is opened, and the inrushing air passes just above the surface of the solvent. By the time the chamber has reached atmospheric pressure, all the solvent has been swept in. Compressed air from a high-pressure cylinder is then admitted into the gasometer, where it mixes with the solvent vapor. When the desired amount of air has been let in, as registered by the gauge, the supply is shut off. A simple calculation then tells just what concentration of vapor and air exists in terms of parts per million. The maximum operating pressure of the gasometer is 150 pounds psi.

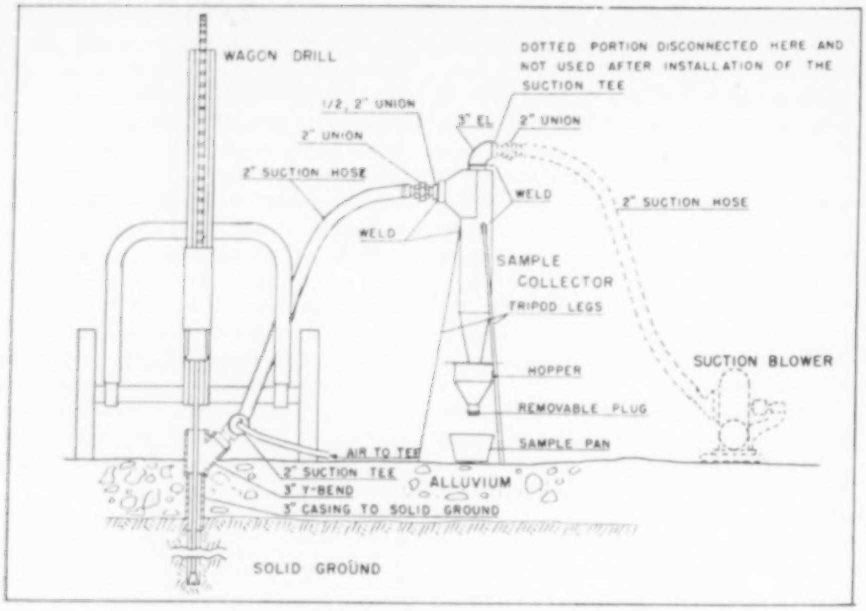
Opening the needle valve releases a stream of vapor-laden air, which is sufficient for a long series of calibrations. By starting off with a heavy concentration of solvent vapor, alternately calibrating instruments, and then admitting more air to dilute the residual moisture, it is easy to obtain a series of different known concentrations.

Only compressed air which is pure is used in the gasometer, and the bureau's laboratory personnel keeps close check on the manner in which it is supplied. This method of using compressed air has saved the bureau many hours of tedious work and has played an important role in assuring adequate health and safety factors in the Detroit workers' environment.



THE GASOMETER

The view at the left shows a technician supplying the gasometer with compressed air from a cylinder in front of him. A measured amount of solvent vapor has previously been admitted, and it is therefore possible to add sufficient air to produce a mixture of any desired concentration. In the other picture he is testing an absorbing device with an air-vapor mixture released from the gasometer.


WAGON DRILL
DOTTED PORTION DISCONNECTED HERE AND NOT USED AFTER INSTALLATION OF THE SUCTION TEE
1/2, 2" UNION
2" UNION
3" EL
2" UNION
2" SUCTION HOSE
WELD
WELD
2" SUCTION HOSE
SAMPLE COLLECTOR
TRIPOD LEGS
SUCTION BLOWER
HOPPER
REMOVABLE PLUG
AIR TO TEE
SAMPLE PAN
2" SUCTION TEE
3" Y-BEND
ALLUVIUM
3" CASING TO SOLID GROUND
SOLID GROUND

Sampling Mineral Deposits with a Wagon Drill

A RECENT report of the U. S. Bureau of Mines describes the sampling of mineral deposits in New Mexico with a standard wagon drill. During the years 1943-45, five separate projects were undertaken in varying kinds of rock formation. Altogether, 317 holes totaling 6852 feet were drilled. The deepest one was 66 feet, and the average depth was around 22 feet.

The accompanying diagram illustrates the set-up of the equipment. The bit cuttings that served as samples were withdrawn through a suction tee at the collar of the hole, several changes in details being made until the most satisfactory arrangement was found—a 2-inch McDaniels suction tee attached by a hose line to the intake of a Buffalo No. 2 blower. Cuttings were delivered to a Multiclone collector manufactured by the Western Precipitation Corporation of Los Angeles. A wooden plug in the bottom of the collector hopper was removed to withdraw the contents into a pail or similar receptacle placed underneath it. Samples were retained wherever the character of the rock being drilled was unknown or in doubt. Where it was known that the formation was barren of commercial minerals, the cuttings were wasted, being led far enough away from the drill so as not to create a dust hazard.

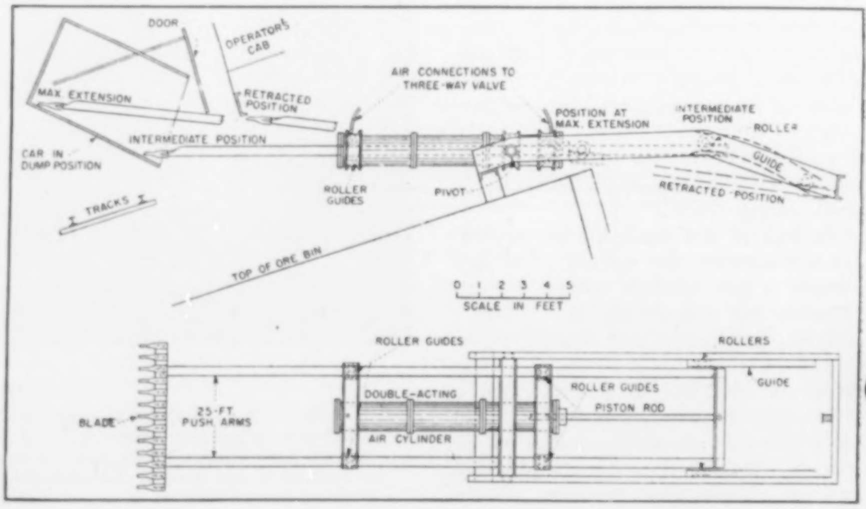
All holes were put in vertically, starting with 3½-inch bits. Where overburden covered the rock it was penetrated, the hole cleaned, and 3-inch casing inserted, the suction tee first being attached to its threaded upper end. Drilling in rock was then begun with a bit small enough just to clear the inner wall of the casing. Hollow round 1¼-inch drill steel in unit lengths of 6 feet was utilized, successive pieces being coupled together as a hole attained depth. All drilling was done with Ingersoll-Rand Jackbits. Reductions of ⅛ inch in gauge size were made when necessary, but several holes in limestone were drilled 50 feet deep with successive bits of the same size as the starter. Compressed air was furnished by a portable unit of 315-cfm. capacity.

Two of the tests were made for fluorite, and one each for copper, iron, and lead-zinc. A driller, a helper, and a sampler made up a full crew, but there were times when only two men were available, and then the helper also attended to the sampling. Although the men employed were unfamiliar with the equipment in the beginning, few difficulties were encountered.

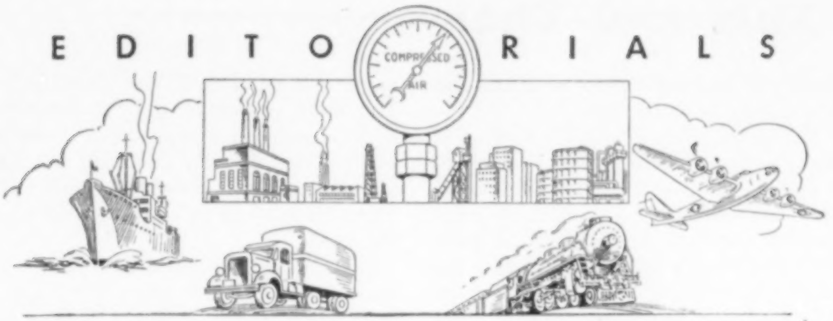
The first sampling with hammer-type drills was done in 1925. It was conducted by wet drilling from underground stations. Subsequently, the method was applied to dry drilling by the addition of a vacuum collector for the cuttings. Wagon mountings were used for surface work, and tripods underground. The latest operations by the bureau followed the earlier efforts in general and may be considered a logical development.

Mine Uses Air-Operated Scraper to Clean Muck Cars

THE accompanying drawing is reproduced by courtesy of the *Engineering & Mining Journal* and shows an air-operated scraper used to clean mine cars at the Climax, Colo., property of the Climax Molybdenum Company. The muck is hauled to a disposal area in Granby-type cars, and any material sticking to the bottom after dumping is removed before they are returned to the mine for reloading. The cleaner is of the retractable type and consists of a toothed blade which is pushed in and out of a tilted car by a pivoted double-acting pneumatic cylinder. The blade is supported by a rectangular frame that moves along with it and is kept in alignment by roller guides. Other rollers and guides at the near end of the frame control the initial stroke so that the teeth engage the car bottom and miss the open door. One or two thrusts of the scraper are generally sufficient. Before the present system was devised, the frozen or packed muck was dislodged by blasting, which had its disadvantages, aside from being slow. Now the man in charge, in a cab near the dump, manipulates a 3-way air valve and cleans a train of twenty cars in ten minutes.


DOOR
OPERATOR'S CAB
MAX. EXTENSION
RETRACTED POSITION
AIR CONNECTIONS TO THREE-WAY VALVE
POSITION AT MAX. EXTENSION
INTERMEDIATE POSITION
ROLLER
INTERMEDIATE POSITION
CAR IN DUMP POSITION
GUIDE
RETRACTED POSITION
ROLLER GUIDES
PIVOT
TRACKS
TOP OF ORE BIN
0 1 2 3 4 5
SCALE IN FEET
ROLLER GUIDES
ROLLERS
GUIDE
ROLLER GUIDES
DOUBLE-ACTING
PISTON ROD
BLADE
25-FT PUSH ARMS
AIR CYLINDER

EDITORIALS



EDUCATION NEEDED

ALTHOUGH it may sound incredible, a surprisingly large number of Americans is not "sold" on America and its system of free enterprise. These people actually believe that they might be better off if all industries and services were controlled by the Government. Manifestly, they don't bother to learn how state control is working out in other parts of the world. Consequently, it is up to those who do know the truth to spread it at every opportunity.

Unlimited facts prove that the existing standard of living in the United States has never been approached elsewhere. They show that the masses here enjoy cultural advantages that are available to only a minor fraction of the peoples in the so-called socialized countries. Yet surveys indicate that a very sizable proportion of our population is either unaware of these truths or prefers to close its eyes to them. The alarming aspect of the situation is that these false impressions are held by groups that are the chief beneficiaries of the rewards of our economic set-up.

If you doubt that this is the case, you have only to note the tenor of the replies received by Dr. Henry C. Link, vice-president of the Psychological Corporation of New York City, when he asked 5000 persons in all walks of life this question: "If the Government owned and managed industries, would you get more or less for your money than you do now?" Of the college students who replied, 63 percent said "as much or more"; 26 percent, "less"; and 11 percent were uncertain. Among the general population, 43 percent responded "as much or more"; 38 percent, "less"; and 19 percent were uncertain. These answers were obtained in October, 1945. Six months later, when the same questions were put to a "general population" group only, 33 percent replied "as much or more"; 35 percent, "less"; and 32 percent were uncertain.

The two principal reasons respondents gave for thinking they would fare better under government control were: "It would eliminate profits" and "it would eliminate unnecessary advertising." Commenting on these deductions, Doctor Link said: "In short, many millions of Americans believe that socialism or state capitalism would be more efficient than the American system of private capitalism."

These astounding expressions came from people of a nation that has more automobiles, more telephones, more bathrooms, more money, and more time for leisure than has any other country. Those who uttered them are either unaware of or prefer to ignore the sorry plight and dismal outlook of the average resident in the lands that have complete or partial state control of industries and services. How can they brush aside the fact that the average Russian has to toil 30 days to earn enough to buy a pair of shoes, while the average American need put in only six hours to do that? Or that the average woman worker in all Europe labors twenty days to pay for a pair of nylon stockings that an American woman can earn in two or three hours?

Writing in the July issue of *Harper's Magazine*, H. Gordon Hayes points out that 70 percent of American boys and girls go to high school, and in some states the percentage is 85 or 90. He cites a Harvard University report showing that from 1870 to 1940 the university population increased fortyfold, while the population as a whole only trebled. He also notes that, whereas 85 percent of our people were required to grow food and to manufacture textiles in 1800, only 15 percent are now so engaged. He predicts that there will be a further reduction to 10 or even 5 percent. Another pertinent observation is that between 1899 and 1939 the man-hours needed for a unit of production in the fields of mining, manufacturing, and agriculture dropped from 100 to 35.

All these advances are attributed to the introduction of mechanical methods and the organization of production on a quantity basis. Responsible for them are the scientific discoveries and technological improvements originated by a relatively few researchers who are supported by the profits of our capitalistic system. Contrast what would have been the result had all goods been divided equally among the people from the time our nation was founded. No one would have had any leisure, and there would have been no progress. Mr. Hayes says we would all probably still be living in tepees.

IN PRAISE OF VETERANS

WE HEAR much about veterans these days. Men who have voted for but one president, if any, are called veterans, and rightly so, because they served their country in time of war. They are one kind of veteran, but not the sort we are thinking about.

The dictionary says a veteran is one who has grown old in service. He is an old stager, an experienced person, an expert, and one who is proficient. Qualifying under these definitions are the many men who have spent most of their lives in industrial plants, or in any of the trades or other fields of useful occupation. Many companies retire men when they reach a certain age, and this is probably good for society because it gives younger men a chance to progress and puts them in responsible posts while they have the vigor that is required to carry heavy loads. In other concerns, men continue to carry on until they can no longer do so. Most of them remain in harness because they like their work and are permitted to stay because their employers have confidence in their ability. Time may have slowed them down a bit, but they have the know-how that makes them valuable to have around.

There has recently come to our attention a letter that a high railroad official wrote to a retired locomotive engineer on his line who had just been made president of the road's veterans' association. The letter is 23 years old, but it pays a tribute to veterans and what they stand for that seems to us to carry a worthwhile message in this age when many young men are undecided whether it pays to work hard at something and learn their jobs through and through. The man who wrote the letter was W. G. Van de Water, then secretary-treasurer of the Delaware, Lackawanna & Western Railroad, and he addressed it to John Draney who had his hand on the throttle of a locomotive years before most World War II veterans were born and who could still take a train out and bring it back if called upon to do so. Here is Mr. Van de Water's appraisal of veterans:

"I feel that one of the highest honors that can come to anybody is to be known as a 'bona fide' veteran. Most any man, if he wants, can become a member of a fraternal organization, and sometimes if he tries real hard he can be a skunk or any other animal or bird, but to be a veteran one has to have earned it through loyalty and devotion and by having qualities not possessed by everybody. Then a man, after the lapse of years that it takes to qualify for such a title, has proved that he is better than the average; because, through all the changes that come in departments and various occupations, a man, to hold on and make good, must have something in him worth while."

This and That

Zinc Die Casting in Germany

Because zinc was relatively plentiful during the war, Germany used its alloys as substitutes for brass and, to a lesser extent, for aluminum and lead, according to a British technical report on the practices of 72 German firms. A chapter on the zinc-alloy die-casting industry contains a description of a novel vertical casting machine into which molten metal is injected by air pressure from a cast-iron bottle. The machine makes castings weighing up to 17½ pounds and has a 24-inch-square die platen.

* * *

Coke from Pellets

With the purpose of determining whether western bituminous coals can be processed so that they will make satisfactory blast-furnace coke, the University of Utah is experimenting with briquettes produced by compressing a mixture of powdered coal and pitch into pillow-shaped pellets about 2 inches square. The briquettes are being converted into coke, which will be tested to learn if it can withstand the weight and heat to which it is subjected in a blast furnace. Coke made directly from most western bituminous coals lacks the necessary strength to support the load put on it and to maintain open spaces through which the stack gases can permeate to do their reducing work. If the tests are successful, steel production in the area west of the Mississippi River will get a material boost. Utah, Colorado, and Wyoming have about 35 percent of the nation's bituminous-coal reserves and 17 percent of the world supply, but little of it is suitable for making coke in the usual manner. James H. Hamilton, who is directing the current experiments, thinks that the method being tried also has possibilities with respect to treating powdered ores of zinc, iron, and phosphate so that they can be smelted more economically than at present.

* * *

Some "Slusher" History

The first printed account of power-drawn scrapers that are used for moving ore or waste rock in mines dealt with tunneling operations in 1898 at the Bunker Hill & Sullivan Mining Company workings near Kellogg, Idaho. The description, written by U. B. Hough, appeared in two trade publications in 1901. This information is contained in a bulletin, *A Study of Mine Scraper Buckets and Their Efficiency*, published as Vol. 17, No. 2 of "Technical Series" by the University of Missouri School of Mines and Metallurgy at Rolla, Mo.

In this initial application, a scraper of the type then commonly drawn by horses in making surface excavations was pulled up a loading ramp by a small air hoist and its contents dumped into a track car. The scraper was hauled back to the muck pile by hand. Five men were required for the operation, three of them for loading and handling the scraper. The rate of loading ranged from 4 to 5.5 tons per hour. That same year a slip scraper, drawn by a small air hoist that had been used for moving mine timbers, was utilized at the Badger Mine in Wisconsin to fill square-set stopes with waste.

During the first years of the present century, J. George Leyner of Denver, Colo., developed a portable air hoist that was intended primarily for mine-scraping service. As there was little immediate demand for it, however, he filed his plans away. Eventually they became the basis for the "Little Tugger" that was introduced in 1912 by Ingersoll-Rand Company after it had purchased the Leyner patents. The original "Little Tugger" was a single-drum, 2½-hp. hoist. It could pull a loaded scraper forward, but the latter had to be returned to the loading face or dragged over the muck pile by manpower. This was tiring work, and several men had to be assigned to it, not only making it expensive as compared with the current practice of moving the scraper both ways by power but also limiting the effective scraping distance to around 50 feet. The scraper held about 3 cubic feet of muck, and sometimes pushed as much as 2 more cubic feet ahead of it. The hoist exerted a pull of 800-1000 pounds and had a rope speed of 80-90 feet per minute. By changing workers frequently, it was possible to load anywhere from 10 to 14 tons an hour with this outfit.

Larry Johnson

"Will you open the second drawer for me?"

Scraper loading increased markedly during World War I, when there was a great demand for metals. It was introduced in the Lake Superior iron and copper mines around 1915 and was tried out in the Tri-State zinc and lead district in 1919. While fighting was going on its use was promoted by the manpower shortage, and during the postwar period its application was favored because low prices of metals forced mine managements to seek ways of cutting production costs. Many operators adopted slushing during the interval from 1923 to 1929, but the practice was not generally accepted in the Tri-State area until 1936.

In recent years the trend has continued, and the advantages of mechanical scraper loading and transport have steadily multiplied as larger and more efficient equipment has been developed. Scraper hoists are now available in a wide range of sizes, and 2- and 3-drum types are common. They will pull a loaded scraper at speeds up to 450 feet per minute, and return it empty to the loading point at up to 600 feet per minute. Nearly all of them are powered either by compressed air or electricity.

* * *

New Tires Use Lower Pressures

Goodyear Tire & Rubber Company is producing a new line of automobile tires, called the Super Cushion, that requires 14 percent less air pressure than current standard models. The reduction is 4 to 6 pounds, according to the size of the tire. In addition, the tire itself is softer and more flexible than the conventional type. These two factors, it is claimed, make for easier riding, even to the point of "smoothing out" railroad crossings and road expansion joints.

Most of the small automobiles on the highways today take a tire 6.00-16 in size. The comparable size in the new line is 6.70-15. It is therefore not suitable for cars produced before 1947, but is standard equipment on new models of several makes of automobiles. Because of the design of its slotted tread, and the fact that reduced air pressure permits the tread to flatten and contact the road surface throughout its full width, the Super Cushion is declared to give better traction and to have more skid resistance than the tires heretofore obtainable.

Flotation Plant in Packaged Units for Assembly

MILLS for sink-and-float ore separation that come in knockdown form ready for use after assembly by bolting are an innovation in the metallurgical-equipment field. Designed by the Western-Knapp Engineering Company, division of the Western Machinery Company, the plant, which is being offered under the name of Mobil-Mill, is delivered in packages containing structural parts, foundations, flooring, handrails, piping and wiring cut to proper length, together with all the machinery of standard type required in the heavy-media separation of ore. The latter consists of a separatory cone, a vibrating screen partitioned lengthwise for both the sink- and float-product washing operations, a steel screen hopper including an adjustable diverting plate for media-return control, a submerged belt-type magnetic separator, a densifier with lifting device, a media circulating pump, a cleaned-media pump, an air compressor and receiver, a motor-generator set, and an electrical control panel wired to protect the direction of the plant flow by an interlocking sequence system.

The prefabricated mill is at present being built in two sizes. One is equipped with a 5-foot-diameter separatory cone and the other with a 7-foot cone treating, respectively, from 5 to 15 tons and from 15 to 25 tons of feed per hour, capacities depending upon the character and the kind of material being handled. The small unit requires an initial charge of 12 to 13 tons of ferrosilicon when the gravity is not to exceed 3.0 and a charge of 8 to 9 tons of magnetite when the gravity is to be not more than 1.8. The larger plant, under similar conditions, calls for 25-27 tons of ferrosilicon and 16-18 tons of magnetite.

Because of its diversity of application, the Mobil-Mill is attracting considerable attention in the mining field. According to the manufacturer, it may be used for research, development, and as a pilot-plant upon which to base the size of a mill for full-scale operations; as a means of producing a shipping-grade ore while proving an ore body; and for treating material in old dumps. It may also be set up in existing plants to serve as a preconcentrator to eliminate valueless content in the feed—to even the grade of the concentrator feed. However, the principal purpose for which the packaged plant is designed is that of a complete heavy-media separator to be used either singly or in units, depending upon tonnage to be handled.

Electronic Sealing of Thermoplastics

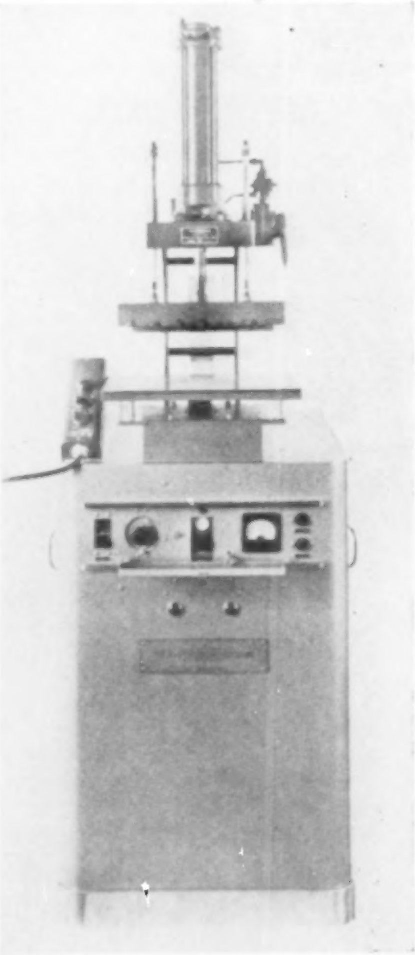
ELECTRONIC sealing or welding of thermoplastics is the latest advance in the fabrication of raincoats, shower curtains, garment bags, food protectors, handbags, and innumerable other articles made of vinylite, Koroseal, Velon Geon, and other synthetic materials of the same order. It has taken the place of stitching or sewing, with its unavoidable perforations and consequent weakening of the fabric. By the new method, films or sheets of these plastics are heated while held in position under pressure, causing them to flow together and to produce an air- and water-tight seam that is said to be stronger than the material itself.

The basic equipment used is a Thermatron, a portable machine developed by Radio Receptor Company, Inc., that converts 60-cycle alternating current into radio frequencies. Standard units are designed to operate at about 27 megacycles (27,000,000 cycles per second) and have a power output ranging from 1 to 5 kw. One kilowatt-hour of electrical energy is equivalent to 3413 Btu's, and the total thermal units required depends upon the specific weight of the plastic being bonded and the temperature rise desired within a given period.

In addition to electronic welding, the Thermatron has many other applications such as preheating preforms (powdered plastics compressed into tablets, cubes, etc.), processing natural and synthetic rubber, curing resin adhesives, molding, drying, and sterilizing. For work of this kind models up to 15 kw. are built and are supplemented by an electrode cage or oven, whereas sealing, with which we are at present concerned, calls for the services of a press.

The press is of the open-jaw type and is operated by a pneumatic cylinder supplied with air by a ¾-hp. compressor, the volume used varying with the job and ranging from 5 to 100 psi. The upper and movable platen is designed to receive detachable "hot" electrodes of different shapes in conformity with the article being welded and is controlled by a hand or foot valve. The lower "grounded" electrode is stationary. With the edges of the thermoplastic sheets held together under pressure between the electrodes, the latter, in combination with the material, acts as a condenser. And as the plastic is the dielectric medium, it is heated throughout as soon as radio-frequency power is applied, causing it to flow together. This takes place in a matter of seconds, it is claimed.

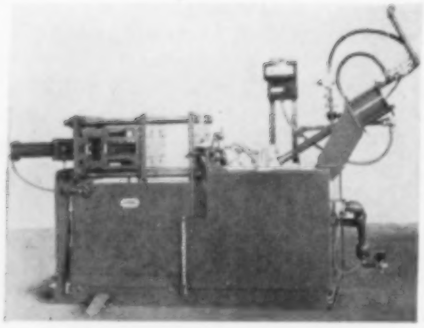
In the manufacture of handbags or small items, the pieces are joined by what the company calls a "one-shot operation," while long seams in raincoats, shower curtains, garment bags, and the like necessitate several downstrokes of the cylinder piston as the work moves along. It is largely a problem of material handling, but lengths up to 72 inches have been sealed by the electronic process on a production basis. Dissimilar materials can be dealt with in the same way. For example, a bond can be effected between vinyl and cotton, rayon, paper, or cardboard, provided the nonplastic is porous or closely woven.



THE WELDMASTER

Equipped with an air-operated press for "heat sealing" thermoplastics, this 2½-kw. Thermatron has an output of 8550 Btu's per hour and can either bond two pieces of vinylite 5 square inches in size and 0.004 inch thick or make a ¼-inch seam 20 inches long in approximately four seconds. The press has an 8-inch stroke and can also be mounted on a 1- or 5-kw. unit. By the application of radio-frequency power, the latter Thermatron generates sufficient heat to weld two 0.008-inch thermoplastic films 16 square inches in area at one downstroke of the piston. Work of different shapes can be handled by interchangeable upper plates, dies, and slotted bar electrodes.

Industrial Notes



For shops that require die castings but not enough to warrant a regular die-casting department, the Cox Hot-Shot machine may be a solution of the problem. It is described as a unit of medium size that needs no trained men to operate it, and it is ready for work when compressed-air, gas, and electric connections have been made. In the right-hand end of the housing is a gas-fired furnace or pot holding 300 pounds of zinc alloy, which is injected into dies by a pneumatic cylinder set at an angle. Another air cylinder at the opposite end of the machine opens and closes the dies through a toggle linkage. A removable bar facilitates die loading, and working parts are readily accessible for inspection and maintenance. Standard equipment includes blow torches for preheating gooseneck and nozzle, a pyrometer, thermocouple, venturi-type gas burner, and Zerk fittings that permit all bearing faces to be lubricated. Maximum die capacity is 1½ pounds of metal, and machine is rated at a maximum of 720 shots an hour.

Ford Motor Company is putting out a gadget labeled Emergency Tire and Fire Unit. It's a small cylinder charged with 10 ounces of carbon dioxide under pressure, enough, it is said, to extinguish an oil or gas fire or to inflate three tires of average size. Spent cylinders are exchanged by Ford for loaded ones.

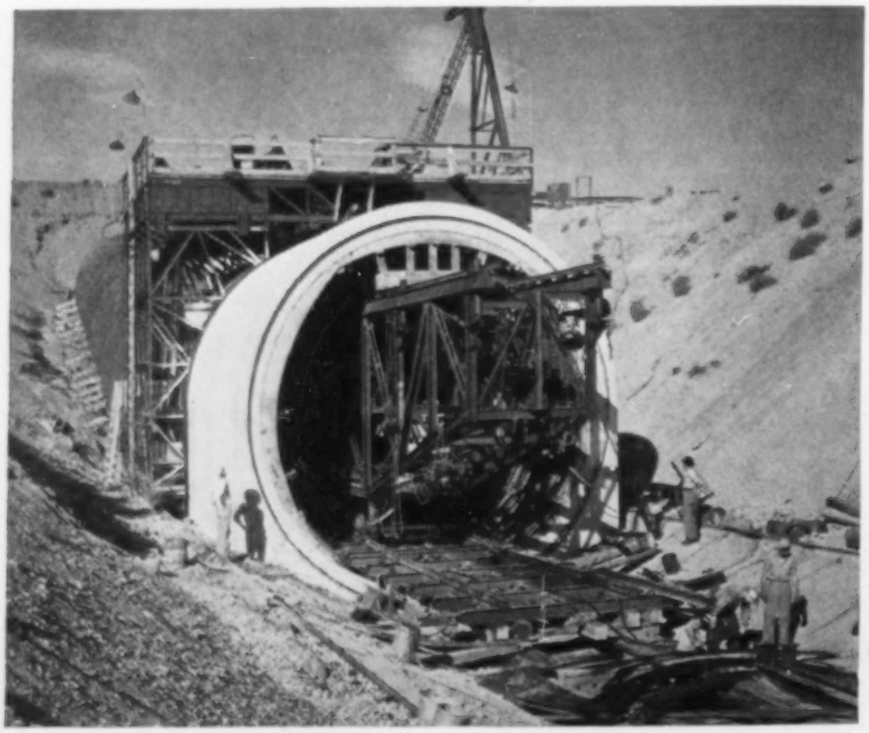
Nylon as a material for safety-valve seats is an innovation and is claimed by Manning, Maxwell & Moore, Inc., to be the only one among the hundreds tested so far to possess all the requirements of wear resistance, hardness, and flexibility. That company is offering a pop valve with a Nylon disk for air compressors and receivers, gas lines, tanks, etc., and reports that the new material does not flow or creep under spring compression, does not stick or weld itself to the seat, is just flexible enough to conform exactly to the seat, and recovers with sufficient rapidity to seal off the slightest gas leakage after a valve pops. The new valve—Type 1664—works against a bronze seat, has an over-all height of 2¾ inches, and is suitable for any set pressure up to and including 250 psi. It comes in standard sizes with NPT male inlet connections of ⅛, ¼, ⅜, and ½ inch.

Designed to measure tension or force in limited spaces found in many types of mechanical assemblies, a miniature dynamometer has been developed by W. C. Dillon & Company. Said to be the smallest of its kind, the instrument has a case diameter of 3 inches and weighs 1 pound complete. Components are die-cast of Zamac No. 3 alloy, and the case is fitted with an unbreakable lucite crystal. The dynamometer is available in 100-, 250-, and 500-pound capacities. The company also makes a larger model for measuring forces up to 20,000 pounds.

By making nails of aluminum, or of some other weather-resistant metal, and by fitting each with a neoprene washer, industry has found a way to prevent leakage around the holes of nails driven to retain metal roofing or siding material. Corrosion resulting from electrolysis is also retarded. One company has developed a machine that slips the washers on nails at the rate of 120 per minute.

For stamping metals, plastics, wood, and other materials by hand, The Acromark Company has redesigned its Hercules Holder carrying interchangeable type. The latter has a larger fillet at the step, and the new heat-treated tool-steel insert permanently mounted in the holder body cushions the type to minimize breakage. Type sizes range from 1/32 to ¾ inch, and for each there is a properly proportioned holder to provide a well-balanced tool.

Decks of colored plastic are to be a feature of the *Mauretania* and are said to have a number of advantages over the familiar wooden planking. The material is fireproof, does not absorb oil or grease, and is resistant to extreme heat or cold, aside from being easily washable and



BUREAU OF RECLAMATION PHOTO

CASTING HUGE CONCRETE SIPHON

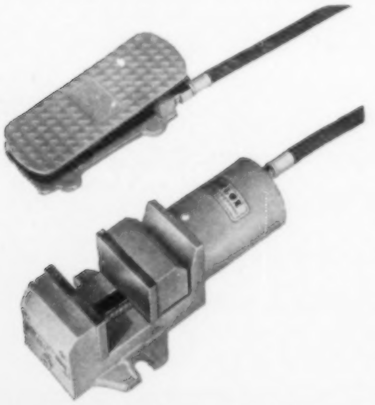
Building 27-foot water conduit for Columbia Basin Project in Washington State. Picture show a section of the 2-foot-thick shell, with inside and outside forms for concrete placing. The outer one has been shoved ahead for another pour around the steel reinforcing hoops, while the inner one is still where it was for the preceding pour. Compressed air is used to operate the hydraulic units on these forms.

thus eliminating that back-breaking job of holystoning—scrubbing with soft sandstone. The idea was conceived on the Clyde—one of Britain's shipyard centers—and was first tried with success on the *Blackburn*, a naval vessel.

For use in one of Europe's rehabilitated mines, Raybestos-Manhattan, Inc., is manufacturing what is claimed to be the world's largest brake lining. A single piece is 30 inches long, 24 inches wide, 5 inches thick, and weighs nearly 300 pounds. To accommodate these big blocks, the company designed and built an extension on the boring-mill table used during the finishing operation. The hoist for which the lining is intended has 22-foot-diameter brake drums and serves a shaft that requires larger and more powerful equipment because of the increasing depth of the workings.

Campbell-Hausfeld Company has acquired and redesigned the Metal Specialties Manufacturing Company's line of spray guns for cleaning and painting surfaces. Model 99-B, for example, is available with an attached quart fluid container or with a larger hose-connected tank. Air at from 25 to 50 psi. is used to operate the gun, and interchangeable tips and caps permit the application of paint, lacquer, or enamel in round or fan-spray pattern. The distinctive feature of the sprayer is that air will continue to flow through it whether the fluid-control trigger is turned on or off, thus preventing clogging and enabling the worker to blow dust and dirt from surfaces before coating them.

Complete with a foot-control valve and 5 feet of ¼-inch hose, Production Devices Incorporated is offering a pneumatic vise under the name of Airlox, Model X. The whole kit weighs 24 pounds, and the vise is said to hold the work with five times the pressure of the air applied. Maximum air-line pressure for which it is designed is 100 psi. Jaw opening is adjustable from ½ inch to 2 inches, and base of vise is keyed and machined for accurate lock-up. Kit is suitable for light press work, drilling, and assembling.



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Copyright 1947, by Victaulic Co. of America

INDUSTRIAL CLUTCH CORPORATION
1930
1946

CLUTCH PROBLEMS SOLVED HERE!

Through this entrance come many and diverse inquiries for clutches to meet special operating conditions.

Our engineering staff devotes its entire time to designing and perfecting clutches for jobs where stock clutches are not applicable.

At present we are in production on clutches designed to meet the particular requirements of air compressors, power shovels, railroad car lighting generators, machine tools, power presses and brakes, starting engines, and other equipment.

The Industrial Clutch plant is equipped with modern precision machines for producing special type clutches in any quantity required, small or large.

We welcome inquiries concerning your clutch problems and are in a position to give prompt service and deliveries on clutches designed to meet your requirements.

INDUSTRIAL CLUTCH CORPORATION

Waukesha Wisconsin

How water climbs a ladder

A typical example of B.F.Goodrich product improvement

AT SOME fires the water has to go high. Firemen have to draw hose up narrow ladders. And they have to do it in seconds.

Fire hose used to be heavy, bulky; it took too much strength and time to lift and carry; it wasted those precious seconds that often determine whether or not lives and property can be saved.

B. F. Goodrich, with more experience in fire hose design and making than any other company, set out to improve this old, standard product and came up with something almost completely new: a new way of twisting the cords to make them stronger; a new rubber compound that is lighter yet stronger, and lasts longer as well; a new way of weaving the cotton jacket that gives greater strength with smaller cords, and no weak spots; in fact, a new fire hose that is 18% lighter yet stronger than ever before; a hose that gets into action faster.

Just for good measure, they developed a new *Koroseal* gasket that can be tightened by hand—cuts coupling time in half, a new and stronger end construction near the coupling where failures used to be common, and a new treatment to prevent mildew.

This often happens at B. F. Goodrich when engineers set out to improve a "standard" product. That's why it pays to ask your distributor what new developments in rubber B. F. Goodrich has made lately in any products you may buy. *The B.F.Goodrich Company, Industrial Products Division, Akron, Ohio.*

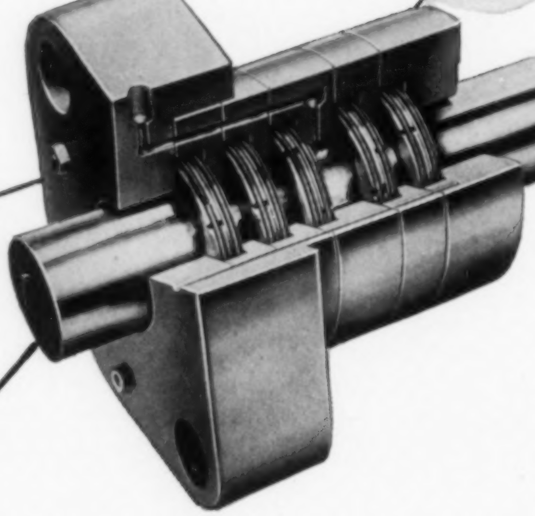
Koroseal—Trade Mark Reg. U. S. Pat. Off.

B.F. Goodrich

FIRST IN RUBBER

BETTER PACKING FOR MORE EFFICIENT RESULTS—THROUGH METALLURGY

COOK METALLIC PACKINGS
pace setters for
EFFICIENCY



★ *. . .they're the standard in many industries*

It is not by accident that Cook Packings have long maintained an enviable record for efficient, dependable operation. Their design and process of manufacture have been subject to constant improvements which have paced the demands for high pressure compressor operation.

As a result, Cook Packings lead the field when it comes to providing maximum sealing at lowest cost, long life and troublefree operation. Their excellent performance under severe service conditions has led many industries to adopt them as the universal standard for all types of compressor operation.

You'll find that it will pay if you, too, standardize on Cook Packings. Specify them by name when ordering new equipment. For existing installations, write us direct.

Sealing Pressures Since 1888

C. LEE COOK MANUFACTURING CO.
INCORPORATED
LOUISVILLE, KY.

BALTIMORE • BOSTON • CHICAGO • CLEVELAND • HOUSTON • LOS ANGELES • MOBILE • NEW ORLEANS • NEW YORK • SAN FRANCISCO • TULSA

FOR ALL MAJOR SERVICES
IN PRINCIPAL INDUSTRIES

Walworth Valves and Fittings

assure low cost dependable performance

Walworth manufactures a **complete line** of valves and pipe fittings for ALL major services in principal industries. All Walworth products are made to the highest standards of quality, both as to dimensional accuracy and metallurgical properties. In design, construction, and performance, they reflect Walworth's 105 years of "know how" in the manufacture of quality valves and fittings.

Your Walworth distributor will give you full information on the **complete line** of Walworth steel, iron, and bronze valves, and pipe fittings; also Walworth Lubricated Plug Valves, and Walseal* valves, fittings and flanges. Ask for this information **today.**

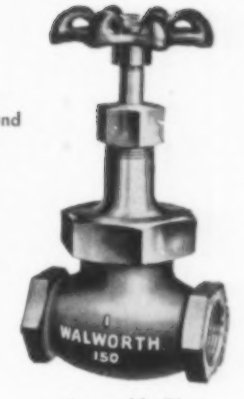
*Patented—Reg. U. S. Pat. Off.

WALWORTH
valves and fittings

60 EAST 42nd STREET, NEW YORK 17, N. Y.

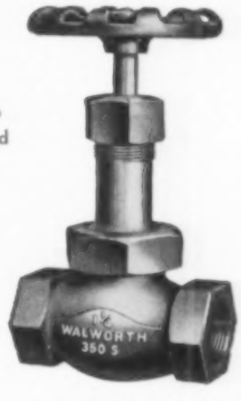
DISTRIBUTORS IN PRINCIPAL CENTERS
THROUGHOUT THE WORLD

No. 95
150-Pound
Bronze
Valve



Renewable Disc

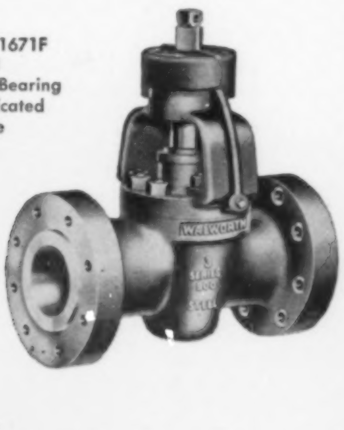
No. 225P
350-Pound
Bronze
Valve



"500 Brinell" Seat & Disc

No. 709
Iron Body
Saddle
Gate
Valve

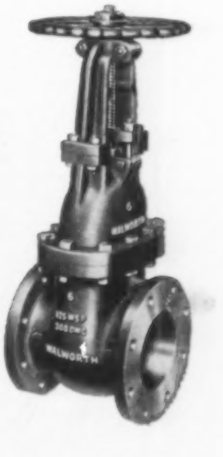
No. 1671F
Steel
Ball Bearing
Lubricated
Valve
Plug



Pressure-
Seal
Steel
Valve

WALWORTH
STEEL

No. 726F
Iron Body
Wedge
Gate
Valve



On Display at the MACHINE TOOL SHOW

Six Popular MADISON-KIPP Lubricators

Madison-Kipp . . . is the most dependable lubrication system ever developed. It is applied as original equipment on America's *finest* machine tools, work engines, and compressors . . . You will definitely increase your production potential for years to come by specifying Madison-Kipp on all new machines you buy where oil under pressure fed drop by drop can be installed.

Madison-Kipp
MODEL 50 LUBRICA
THE MOST DEPENDABLE METHOD OF LUBRICATION EVER DEVELOPED
Fresh Oil
Fresh Oil DROP BY DROP UNDER PRESSURE FROM THE MODEL
CV
MADISON-KIPP LUBRICATOR
THE MOST DEPENDABLE METHOD OF LUBRICATION
Fresh Oil...
BY THE MEASURED DROP
the most dependable method of lubrication ever developed
MODEL FD
MADISON-KIPP CORPORATION Madison 4, Wisconsin
MADISON-KIPP MODEL SVD LUBRICATORS
BULLETIN L-2401

- *Skilled in* DIE CASTING *Mechanics*
- *Experienced in* LUBRICATION *Engineering*
- *Originators of Really High Speed* AIR TOOLS

MADISON-KIPP CORPORATION

202 WAUBESA STREET, MADISON 4, WISCONSIN, U. S. A.

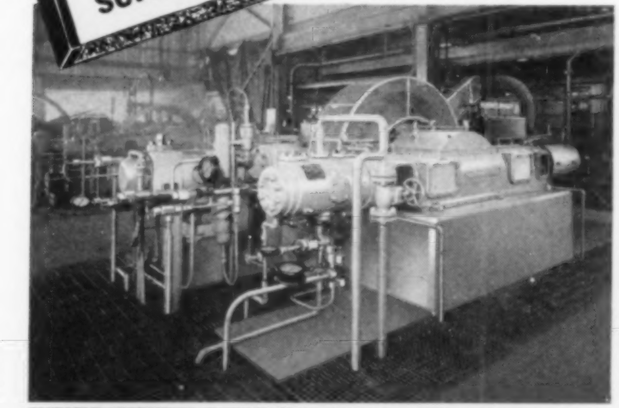
ANCIENS ATELIERS GASQUY, 31 Rue du Marias, Brussels, Belgium, sole agents for Belgium, Holland, France, and Switzerland.

WM. COULTHARD & CO. Ltd., Carlisle, England, sole agents for England, most European countries, India, Australia, and New Zealand.

Petro-chem-ability

SUITABILITY CONTROL-ABILITY DURABILITY DEPENDABILITY ACCESSIBILITY

the Yardstick for Process Compressors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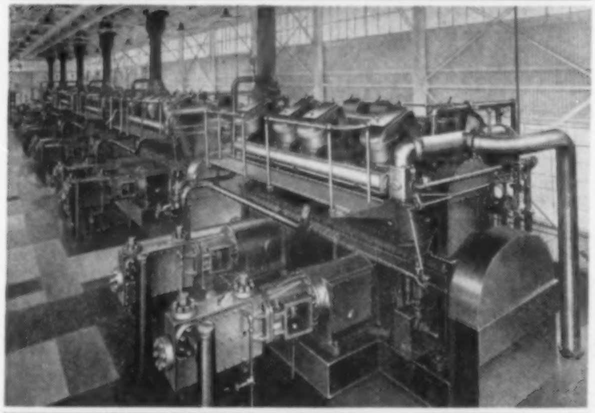
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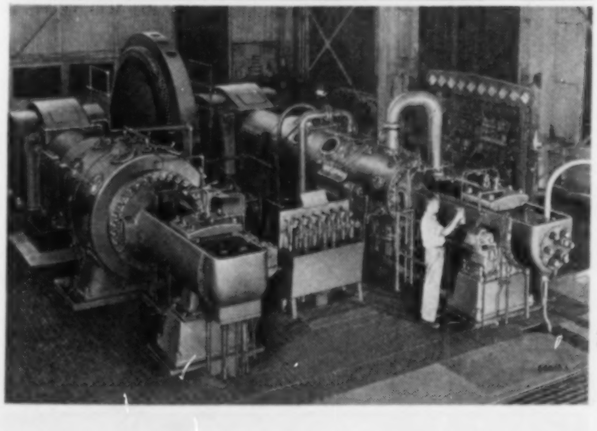

3

In a process plant, this yardstick scales values that cannot be measured in dollars first cost, cubic-feet capacity, or horsepower of the compressor itself . . . but, more important, in terms of sustained production, quality of product, and safety in operation of the process.

The best way to be sure a compressor has *Petro-chem-ability* is to select a manufacturer with years of actual engineering experience in building and applying compressors of all types for all kinds of processes . . . for handling all sorts of gases . . . and for all ranges of pressures.

Ingersoll-Rand has that experience and can help you solve your compression problems.

●

1 *Steam-Driven* . . . Three Type XVP 3-stage hydrogen Compressors discharging at 5500 psi pressure in a chemical plant. Two are 130-hp units, the one in the background a 500-hp.

2 *Gas-Engine-Driven* . . . Six 800-hp Type KVG Compressors in recycling service, 4100-psi discharge.

3 *Electric-Driven* . . . A 2500-hp 7-stage Compressor operating at 15,000-psi pressure in a synthetic-ammonia plant.

ROCK DRILLS • COMPRESSORS • AIR TOOLS •
CENTRIFUGAL PUMPS • TURBO BLOWERS
OIL & GAS ENGINES • CONDENSERS

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

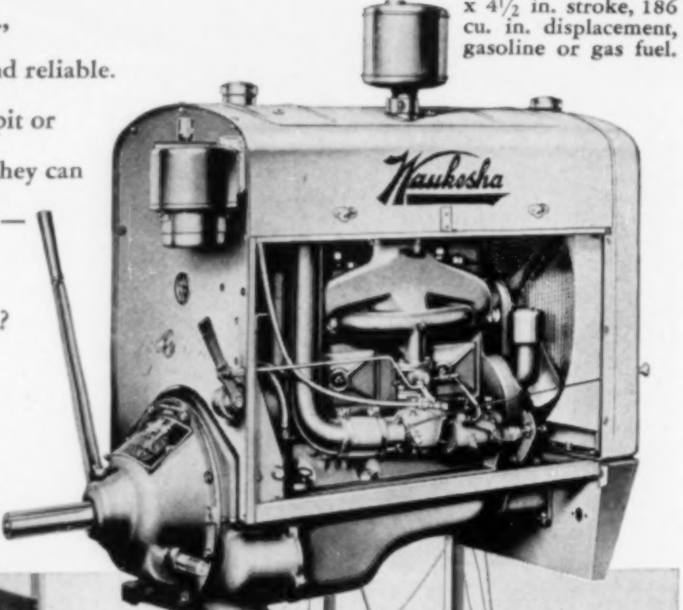
80-1

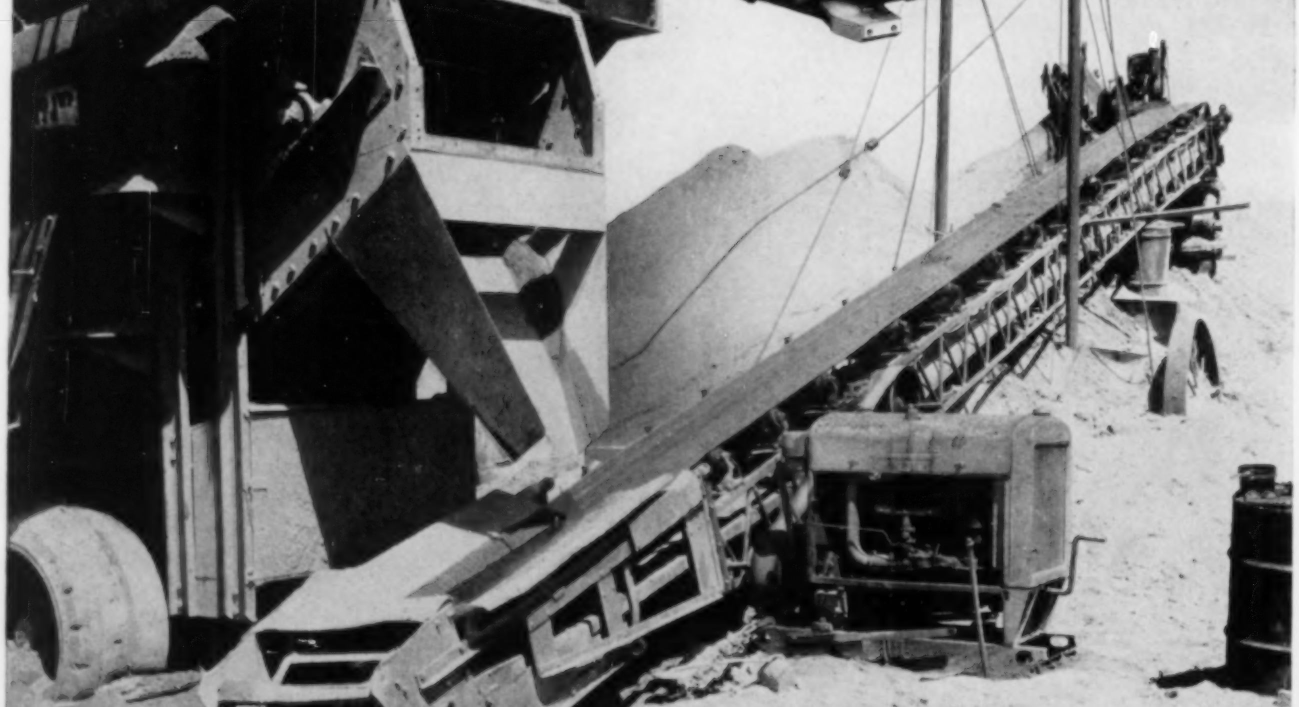
rock-rugged POWER for top tonnage

For a smooth, uninterrupted flow of aggregate in a gravel or rock crushing plant — crushers, conveyors, etc., must have power plants that are *both* rugged and reliable. There's no place for a feather-bed engine in a pit or a quarry. But Waukeshas are right at home. They can not only take the loads, but dish out the power — quickly, easily, smoothly — without calling for time out. And do it all with less fuel. Why? Waukeshas are built to do it. How? Bulletin 1408 tells you. Send for one.

WAUKESHA MOTOR COMPANY, WAUKESHA, WIS.
NEW YORK TULSA LOS ANGELES

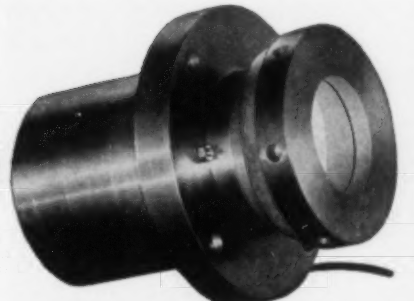
MODEL XAHU—4-cyl., $3\frac{5}{8}$ in. bore x $4\frac{1}{2}$ in. stroke, 186 cu. in. displacement, gasoline or gas fuel.





Model XAHU Waukesha Power Unit keeps the conveyor running in a gravel pit near Medina, Wisconsin.

WAUKESHA ENGINES



LONGER WEAR

and...
Trouble-free Operation

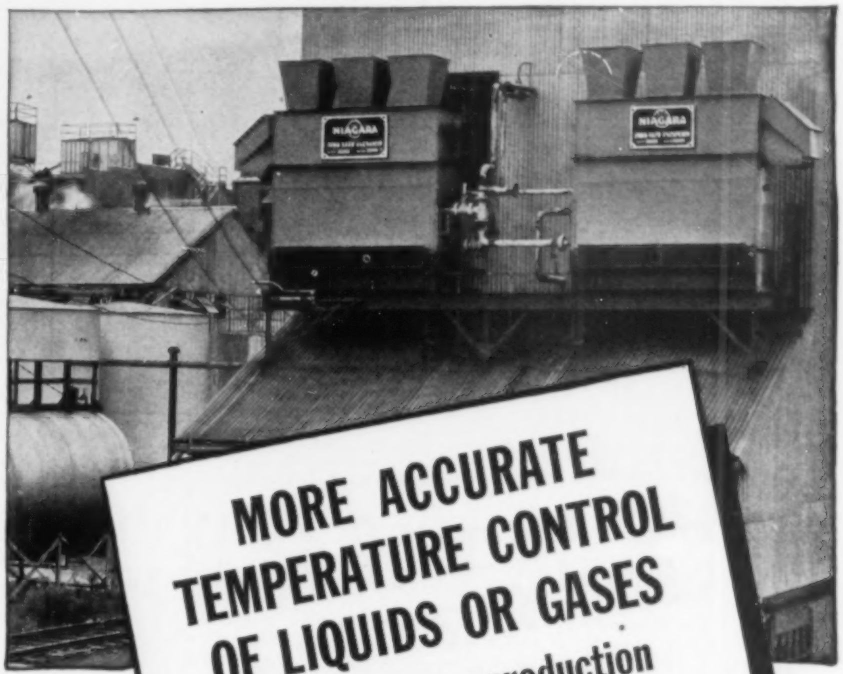
FRANCE Metal Packing gives maximum sealing efficiency, reduces friction and prevents rod scoring. Records show it lasts longer and lowers maintenance costs. There is a France Metal Packing designed to meet every condition of service on engines and compressors operating at pressures up to 15,000 pounds and more. Consult our engineers on your packing problem.

Write Today for Free Brochure ... "Industrial Packing"

The Tangential design of the France Ring is the principle of excelling performance.

REPRESENTATIVES IN PRINCIPAL CITIES

FRANCE
PACKING COMPANY
PHILADELPHIA 35, PA.



MORE ACCURATE TEMPERATURE CONTROL OF LIQUIDS OR GASES

...to improve production and save expense

- The Niagara Aero Heat Exchanger is used as a liquid or gas cooler in many industrial processes such as cooling jacket water for engines or process equipment; cooling lubricants, cutting oils, quenching baths, electronic sets, transformers, controlled atmospheric processes; condensing of steam, vapor, acid gases; compressed air or gas cooling.

Compared to conventional methods, it saves the cost of over 95% of the cooling water and its attendant piping and pumping. Its extra advantage, closer control of temperatures, has been found vastly more important in improving the efficiency of operation, increasing production and reducing maintenance troubles and expense.

Write for further information and examples in specific processes. Ask for Bulletin 96-CA.

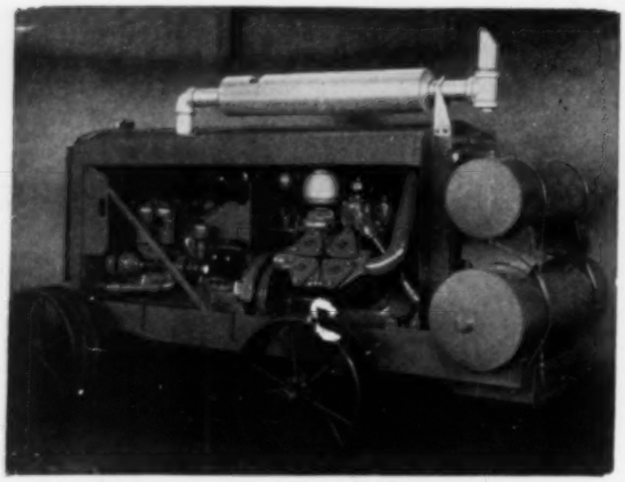
NIAGARA BLOWER COMPANY

Over 30 Years of Service in Industrial Air Engineering

405 Lexington Ave. New York 17, N. Y.

Field Engineering Offices in Principal Cities

INDUSTRIAL COOLING HEATING • DRYING
NIAGARA
HUMIDIFYING • AIR ENGINEERING EQUIPMENT



MAXIM EQUIPPED FOR GOOD PUBLIC RELATIONS

A portable compressor is apt to spend its service life in many locations where noise is a nuisance to nearby homes and offices. It is good public relations to provide adequate silencing and good practice to choose Maxims for this job. For superior silencing of engine exhaust and intake, compressor intake, steam or air blow-off; for spark arresting or silencing with the heat recovery feature, specify Maxims. Detailed bulletins on request.

THE MAXIM SILENCER COMPANY
61 HOMESTEAD AVENUE, HARTFORD 1, CONN.

MAXIM SILENCERS

Here is the pair for clean, dry air . .

JOHNSON AFTERCOOLER

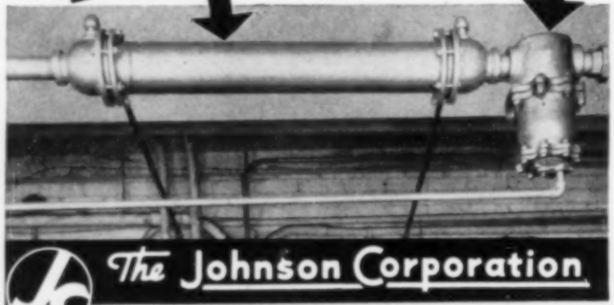
Used where moisture is vaporized by the heat of compression. Circulates cooling water around the line, condenses the oil and water vapor so Separator can remove them. Simple in design, highly efficient in performance.

SIZES FOR ALL NEEDS

JOHNSON SEPARATOR

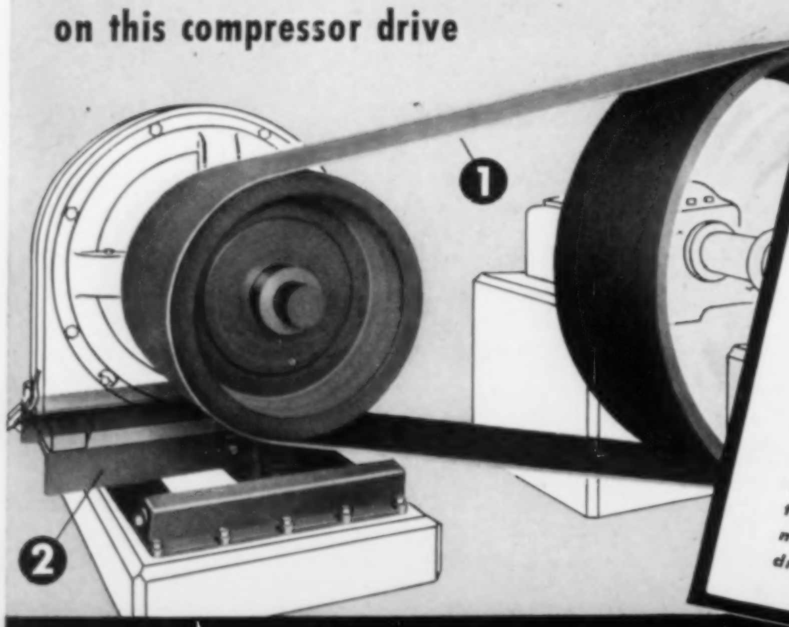
Removes more than 99% of all water, dirt and oil from compressed air or steam. Combines the *two* best principles of separation—first allows air to expand slightly, then changes flow direction with the "Thousand Baffles". Model illustrated is the newest idea in separator design, with self-draining trap mechanism built right in.

WRITE FOR BULLETIN



The Johnson Corporation
830 Wood St., Three Rivers, Michigan

BELT AND BASE PROTECT BEARINGS on this compressor drive



Here's how Schieren Duxbak belt on the pulleys and a pivoted motor base minimize wear on motor and compressor bearings.

1 **THE SCHIEREN BELT** has extra pulley grip which comes from a clean, uniform open grain surface. The extra pulley grip enables the belt to carry heavier loads at lower tensions . . . easing the stress on bearings.

2 **THE PIVOTED MOTOR BASE** provides automatic belt tension control. This provides instant compensation for overload with minimum strain on belt and bearings.

Write for complete, free information on Schieren belting and the modern pivoted base short center drive.

CHAS. A. SCHIEREN COMPANY
35 FERRY STREET, NEW YORK 7, N. Y.
60 Front Street, W., Toronto, Ont.

Branch Offices in Chicago, Dallas, Denver, Detroit, Newark, New York, Philadelphia, Pittsburgh, Salt Lake City

Tanners and Manufacturers of Leather Belting, Packings and Specialties Since 1868

SC-16

"SUBWAY"
R
INC.
PHILADELPHIA
SUBWAY

The Original HEAVY DUTY AIR HOSE...

Developed by Goodall nearly half a century ago, to permit higher drilling pressures on an important tunnel project. Improved during the years to meet increasingly critical requirements. Today, a "Standard of Quality" product, unequalled for strength, durability and safety. Sizes ½" to 1-¼", in 50' lengths.

Contact Our Nearest Branch for Details and Prices

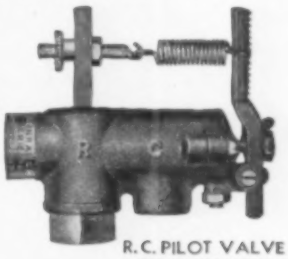
GOODALL RUBBER CO., INC.

THE GOODALL-WHITEHEAD COMPANIES

Philadelphia • Trenton • New York • Boston • Pittsburgh • Chicago • St. Paul • Los Angeles
San Francisco • Seattle • Salt Lake City • Houston • Factory: Trenton, N. J. • Est. 1870

R. C. PILOT VALVES FOR POSITIVE CONTROL

R-C Unloader Pilot Valves (plain or strainer type) are standard on many leading compressors...installed as replacements on thousands of compressors in all parts of the U.S.A. and overseas. The R-C valve—positive in action—cannot chatter...it's always in open or closed position. Adjustment is provided for any unload-to-load range from 3% to 30% of maximum receiver pressure. Install an R-C Unloader Pilot valve—let performance prove its value. Specify air pressure and range of on-and-off operation desired. Write for price and recommendation.



R.C. PILOT VALVE
STRAINER TYPE

R. CONRADER CO.
1207 FRENCH STREET - ERIE, PA.
PILOT VALVES for Portable and Stationary Air Compressors provided with Unloaders

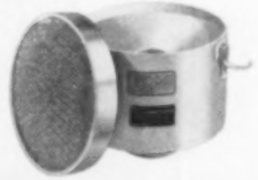
GOOD NEWS

FOR FILTER USERS

Here's a completely new type of intake Cleaner-Snubber that offers many advantages to users. First of all, it can be mounted directly on the inlet or intake pipe in any position. Second, the filter element is quickly removed by unsnapping three fasteners that can't come off and get lost. The element itself is easily handled for cleaning and servicing.

Third, a surge Snubber, built into the body of the unit, smooths the flow of intake air and thereby removes the source of intake noise. And fourth, it is sturdily built of heavy steel to give it long service life.

We offer this new Model ICS unit to users of compressors and blowers with full confidence in its performance. Write for the catalog sheet on Model ICS for complete description, sizes, and other information.



BURGESS-MANNING COMPANY
749-P East Park Ave., Libertyville, Illinois

116% MORE POWER PER POUND . . .

Up to 134% more starting torque per pound of motor . . . with as much as 116% more maximum torque per pound! As much as one third smaller . . . yet stronger mechanically AND electrically than any previous Westinghouse induction motor!

That's the achievement represented in the Westinghouse Life-Line—the biggest single advance in fundamental motor design in 58 years.

It wraps up in one solid steel-encased package, user preferences formerly obtainable only as custom-built features, if at all.

It makes available to industry, in a standard line of motors, improvements perfected for special wartime requirements.

Life-Line Motors are now in production at the new Buffalo Westinghouse Motor Plant, in frame sizes representing the popular demand of induction motor ratings. Check your nearest Westinghouse office for availability, or write Westinghouse Electric Corporation, P. O. Box 2025, Buffalo 5, N. Y.

J-21403

Westinghouse

PLANTS IN 25 CITIES . . . OFFICES EVERYWHERE

Life-Line motors

up to 1/3 less space!
Features and improvements demanded most by users—
ALL WRAPPED IN A SINGLE PACKAGE!

ALL-STEEL PROTECTION

All frames, feet and brackets are HEAVY STEEL. Stators are far stronger . . . new core locking device eliminates rivets.

NO LUBRICATION FOR 5 YEARS

No greasing is needed for AT LEAST FIVE YEARS. Bearings are pre-lubricated . . . sealed against dirt and moisture.

NEW QUIET SMOOTHNESS

Life-Lines cut vibration and noise to new low limits for standard motors . . . satisfy many "special motor" needs.

LESS SPACE PER HP

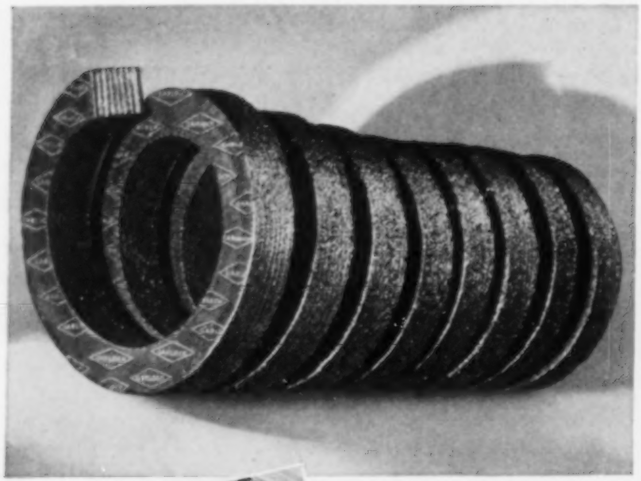
Life-Line Motors occupy less space per hp than any other standard motor . . . are easier to build into machines and install in cramped quarters.

IMPROVED WINDINGS

New insulating materials . . . coil winding techniques . . . stator slot designs . . . give new record-setting protection against electrical failures.

NEW SLEEK LINES

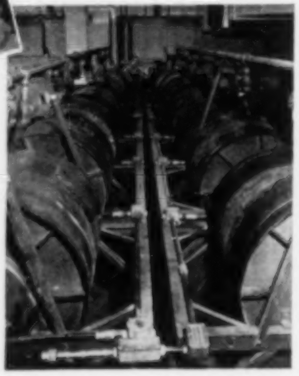
The Life-Line has sleek lines . . . a smooth finish . . . discourages dust and dirt accumulations . . . harmonizes with modern machine and tool design.



Above: GARLOCK 777 Spiral. For rings specify GARLOCK 333.

Left: One of the rubber mills at the GARLOCK factory.

Below: A Battery of rubber cement mixing tanks.



Rubber and Duck

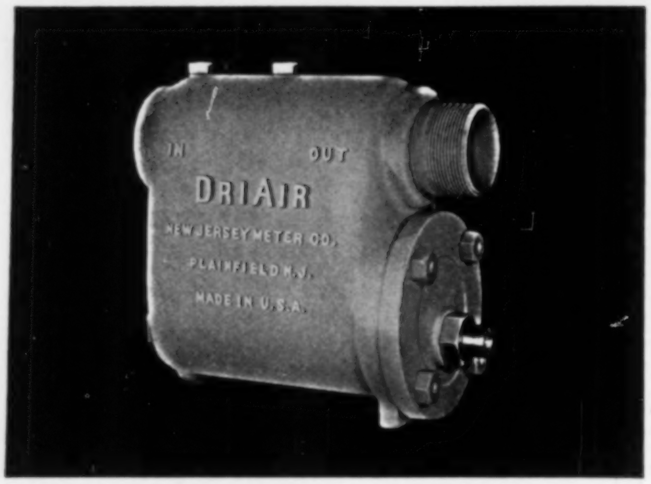
GARLOCK 777 Low Pressure Packing is constructed of plies of closely woven duck, bonded together with a special rubber compound and finished with top and bottom covers of heavy rubber. Recommended for hot or cold water and low pressure steam. For long dependable packing service, use GARLOCK 777.

Also for Ammonia—GARLOCK Rubber and Duck packing is also specially treated for ammonia service—specify GARLOCK 778 Spiral; GARLOCK 334 Rings.

THE GARLOCK PACKING COMPANY
PALMYRA, N. Y.
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.
60th Anniversary 1887—1947

GARLOCK 777

DEPENDABLE PNEUMATIC SERVICE



WHEN EQUIPMENT IS PROTECTED BY

DRIAIR

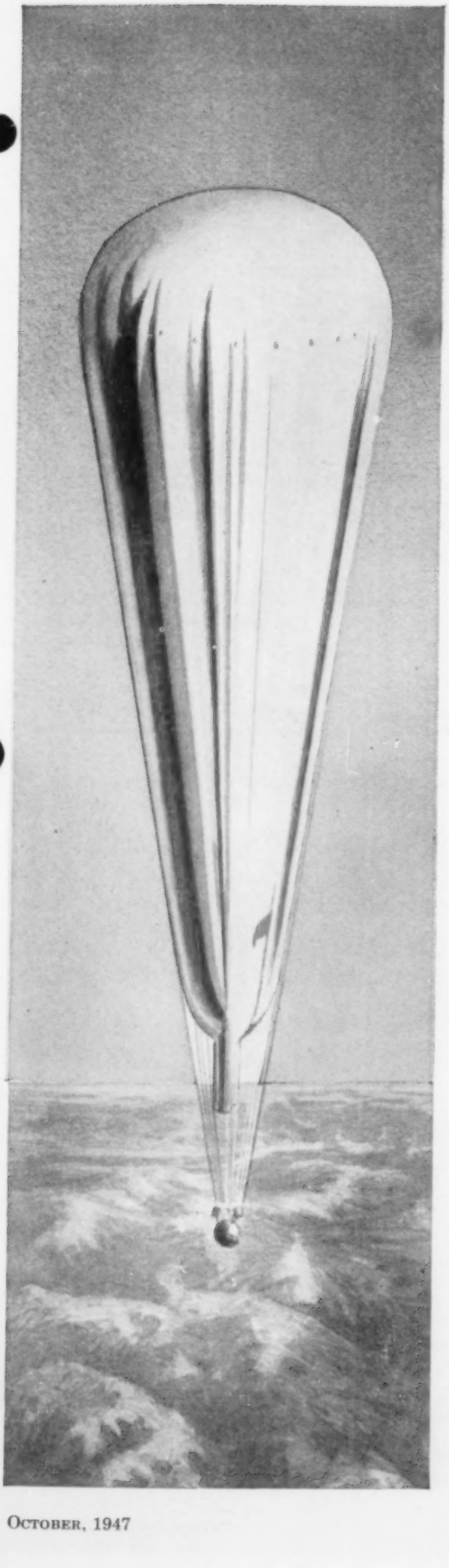
A COMPLETE SELF-CONTAINED UNIT

DriAir may be installed by suspending it from the piping, without any other support, or may stand on the floor near equipment being protected

DRIAIR speeds production by separating and automatically ejecting the condensed water and oil from the air. DriAir collects dirt and rust from the air lines and delivers clean dry air to the tools, thus reducing wear and prolonging their life. All internal parts are made of bronze or copper – resistant to corrosion and practically permanent. Copy of Bulletin DA fully describing the operation of DriAir sent on request.

NEW JERSEY METER COMPANY

PLAINFIELD, NEW JERSEY



What's the Limit?

In the world's largest balloon, *Explorer II*, Captain Albert W. Stevens reached an altitude of 72,395 feet, the highest man has ascended into the stratosphere. How high can man soar above the earth's surface? What's the limit?

IS *Porous Chrome*
THE ENGINE-LIFE PISTON RING?

We can't be sure, *yet*. But from the performance of millions of rings now in service on gasoline and diesel engines, it's not unlikely!

Koppers Porous Chrome* multiplies piston ring life by four—*even five!* The gentle honing action of these rings causes the entire set to seat within the first hour of operation, eliminating the costly and destructive break-in period, cutting cylinder wear *in half!*

These amazing piston rings are produced for all types of compressor equipment. Specify them on new equipment. Use them on overhauls. For more specific details on your motor, address Koppers Company, Inc., Piston Ring Division, Box 626, Baltimore 3, Maryland.

*[Van der Horst Process]

K
KOPPERS

American Hammered Piston Rings

IN EVERY SIZE—OF EVERY TYPE—FOR EVERY SERVICE

EVERYBODY WANTS ONE!
(and they're going fast!)

HOSE COUPLING HANDBOOK —and Service Manual

Short cuts for increasing the efficiency and lowering the operating cost of equipment using hose couplings and accessories

LE-HI HOSE COUPLINGS

HOSE ACCESSORIES COMPANY
LEHIGH AVENUE AT 17TH STREET • PHILA. 32, PA. U.S.A.

get your copy from your LE-HI distributor NOW, while his supply lasts! . . .

Here is REAL information about Hose Couplings—how to buy them, how to install them, how to use them, how to get the most out of your equipment. Facts that will save you *time*, and *money*. Handy size—just right for your pocket.

If you buy or use hose couplings, you should have this book!

Remember, LE-HI Hose Couplings and Fittings are sold only through leading distributors and rubber manufacturers.

"LE-HI makes a good connection"

HOSE ACCESSORIES CO.
2716 NORTH 17TH STREET • PHILA. 32, PA.

LE-HI HIGH and LOW PRESSURE HOSE COUPLINGS

Nicholson Catalog 546 Shows

FAST ACTING · SLOW WEARING Control Valves

for Every Operating Purpose

Style E, 4-Way

Featuring specially treated seats that don't cut out, Nicholson cylinder control valves are heavy-bodied, generously packed, fast-acting units, recognized for the way they stand up. Metal combinations for specific needs. Lever, foot, solenoid, motor types for all mediums. Pressures to 5000 lbs.

Catalog 546
or see Sweet's

REPRESENTATIVE INSTALLATIONS

- *Brakes · Clutches*
- *Gates · Dumps*
- *Control Instruments*
- *Air Hoists*
- *Steel Furnaces*
- *Large Gate Valves*
- *Automatic Controls*
- *Larry Cars · Cranes*
- *Bus Doors*
- *Locomotives*

W. H. NICHOLSON & CO.
180 OREGON ST.
WILKES-BARRE PA.

FOR AIR COMPRESSORS

Class 9213
type DHG · form X

PRESSURE SWITCH

200 lbs. pressure limit
15 to 40 lbs. differential

• A two-pole device for intermediate-sized motors. Simply-designed, huskily-built mechanism delivers long life and trouble-free operation with a minimum of servicing.

Quickly wired. Range and differential easily adjusted in the field. Offered with or without pressure-release valve for easier motor starting.

Write for Bulletin • photos, specifications of Square D pressure switches and related devices. Address Square D Company, 4041 North Richards Street, Milwaukee 12, Wis.

SQUARE D COMPANY
DETROIT • MILWAUKEE • LOS ANGELES
SQUARE D CANADA, LTD., TORONTO, ONTARIO • SQUARE D de MEXICO, S.A., MEXICO CITY, D.F.

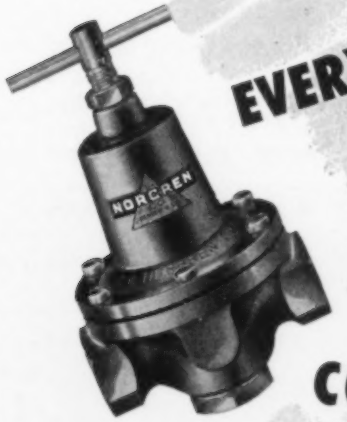
THE MOST BRILLIANT NAME IN LEAD PENCILS

KOH-I-NOOR

Like the WORLD FAMOUS KOH-I-NOOR DIAMOND, KOH-I-NOOR PRODUCTS have long been famous for their outstanding qualities. Whatever is required in pencil performance will be found in our exceptional quality lines.

Send for your copy of our catalog

KOH-I-NOOR PENCIL COMPANY, INC.
BLOOMSBURY, N. J.



EVERYTHING'S UNDER CONTROL

Norgren Regulators insure correct air pressure in the line and keep it there. Automatic. Fast acting. Dependable. **Floating Diaphragm** insures fast action and long life. **Baffle Plate Action** provides decisive opening and closing. **Syphon Tube** permits greater volume of air to pass with less pressure drop than conventional regulators. Sizes: 1/8" to 1" inclusive.

Write for catalog No. 400. C. A. Norgren Co., 222 Santa Fe Drive, Denver 9, Colorado.

Norgren

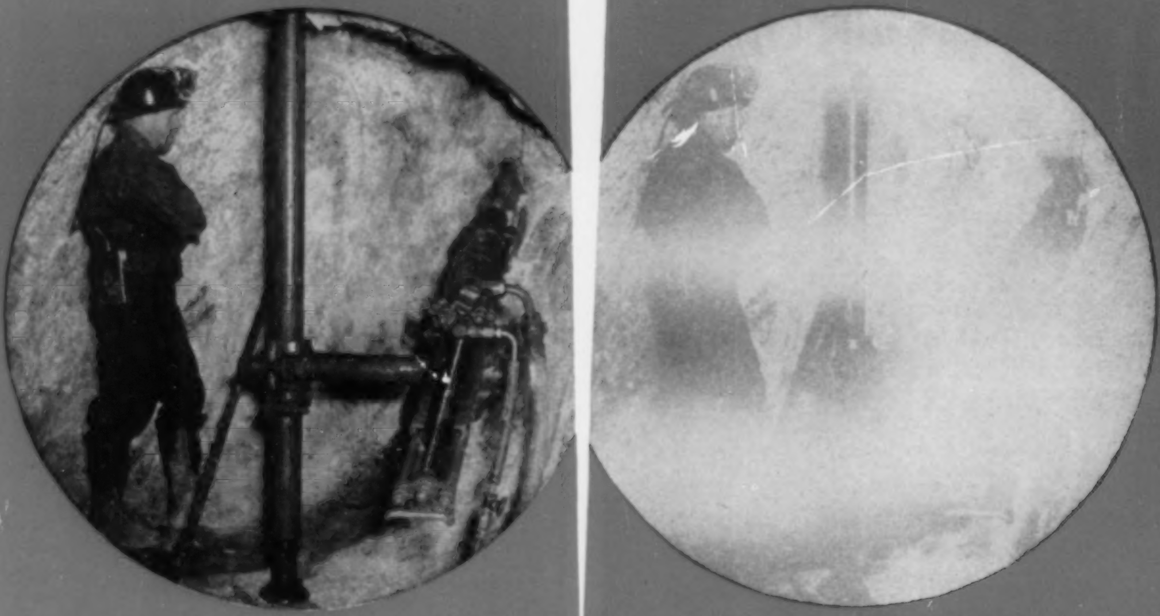
To Have and to Hold Attention–

"Pneuphonic" Air Horns are toned to a distinctive, penetrating note that commands attention. Operating on 75-140 psi, they install anywhere that compressed air is used. Sound ratings range up to 109 decibels at 100 feet.

Non-directional property give them deep penetration in all directions, over large areas. This tone-carry won acceptance for widespread use as air raid warnings.

Factory Mill
Mines Highway Yards
Crossing Warnings
Fire Alarms
System Signaling
Marine-Vessels, Shore and Fog Alarms
Railroads

Westinghouse Air Brake Co.
Industrial Division - - - Wilmerding, Pa.


Now you see it!
Now you don't!

NOBODY LIKES FOG!

Whether you're driving—or drilling—fog's no fun. Your operators object to an oil in rock drills or pneumatic tools which exhausts "fog." And you'll object, too, because oil that fogs isn't doing its proper job of lubricating air tools.

Houghton's STA-PUT Lubricants for pneumatic tools are treated to give them great cohesion and to enable them to adhere to metal surfaces. They resist leakage . . . *stay put,* as their name indicates. Further, they have high lubricating ability, and are also treated to carry heavy loads, preventing metal-to-metal contact. They permit maximum drill speed for longer periods. They won't fog, gum nor corrode.

Those are reasons why so many mines and quarries the world over use STA-PUT Lubricants. May we send you descriptive folder and prices? E. F. Houghton & Co., 303 W. Lehigh Ave., Philadelphia 33, Pa., and San Francisco, Calif.

Houghton's STA-PUT ROCK DRILL LUBRICANTS

AMAZING all-purpose Electric IMPACT Tool

● What other electric tool would permit you to ream 3/16" of metal from a steel plate held in your hand!

Action photograph
Reaming 1/4" to 7/16" in steel plate
f32 at 1/5000 sec. Electroflash
Impact Tool fitted with No. 2 Morse
Taper Socket and 7/16" tapered reamer.

The amazing Ingersoll-Rand Impact Tool (the only universal electric rotary *Impact* Tool in the world) is easy to hold . . . you get no torque reaction—no kick—no twist—under any condition. A patented mechanism converts the power of the electric motor into "rotary impacts" (1900 per minute) which exert a more powerful turning effect than is produced by any other electric tool of comparable size.

AMAZING! – Even if you stall the spindle completely the motor continues to run—no burned out motors when you use the IR Impact Tool.

AMAZING! – You need only one (1) IR Impact Tool and standard attachments to perform all of the operations listed.*

AMAZING! – Delivery from stock . . . See your nearest Jobber or Distributor.

*

- **Applies and removes nuts**
- **Drills**
- **Reams**
- **Taps**
- **Drives and removes screws**
- **Drives and removes studs**
- **Extracts broken cap screws and studs**
- **Runs wire brushes**
- **Does hole saw work**
- **Drills brick and masonry**
- **Drives wood augers**

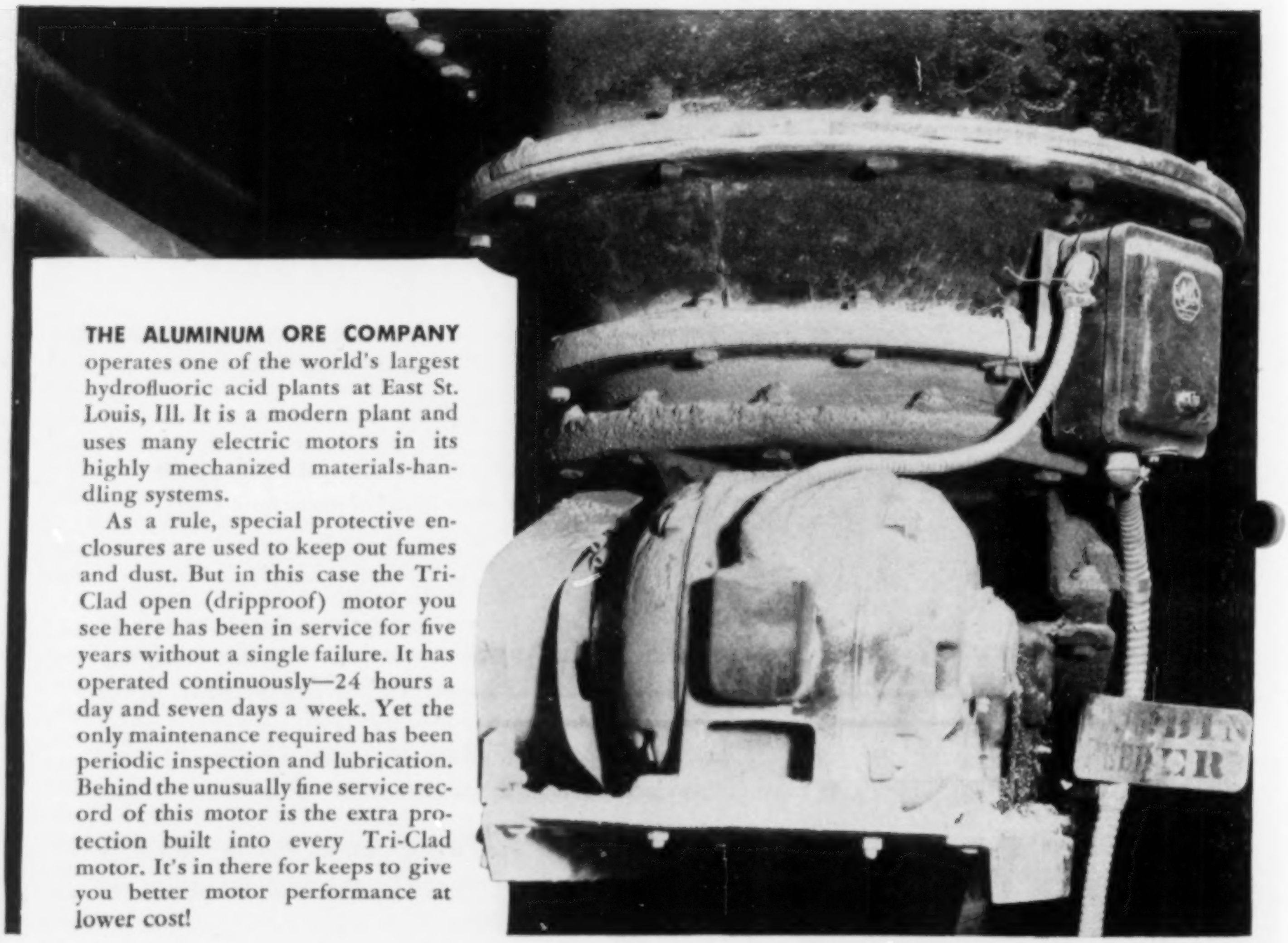
Uses standard attachments

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

58-18

4 MILLION HP •



THE ALUMINUM ORE COMPANY operates one of the world's largest hydrofluoric acid plants at East St. Louis, Ill. It is a modern plant and uses many electric motors in its highly mechanized materials-handling systems.

As a rule, special protective enclosures are used to keep out fumes and dust. But in this case the Tri-Clad open (dripproof) motor you see here has been in service for five years without a single failure. It has operated continuously—24 hours a day and seven days a week. Yet the only maintenance required has been periodic inspection and lubrication. Behind the unusually fine service record of this motor is the extra protection built into every Tri-Clad motor. It's in there for keeps to give you better motor performance at lower cost!

The toughest TRI/CLAD ever built!

Newest addition to the Tri-Clad motor family is the Tri-Clad totally enclosed, fan-cooled motor. It is designed for use in adverse atmospheres—in iron dust, out-of-doors, in hazardous areas, and chemical atmospheres. Available in both standard and explosion-proof types, this motor gives you these important construction features:

- A cast-iron, double-wall frame which completely encloses and protects the windings and punchings.
- A non-shrinking compound around motor leads which protects motor interior from dust and moisture.
- A rotating labyrinth seal which further protects the motor interior from damage by foreign matter.

CONFIRMS IT!

FOR TOUGH MOTOR JOBS, YOU CAN'T BEAT

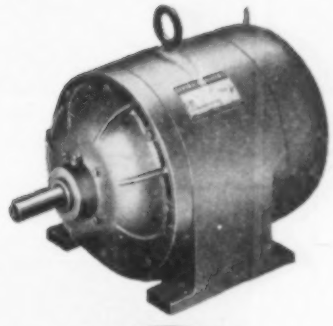
TRI-CLAD

EXTRA PROTECTION

To date, a million and a half Tri-Clad motors, with a total output of over 4-million horsepower, have been purchased by American industry!

In every kind of plant from steel mill to dairy, these motors are proof beyond doubt that you can't beat Tri-Clad extra protection for tough motor applications. Even on jobs where special protective enclosures would ordinarily have been specified, Tri-Clad open motors, applied during the war years, have stood up to heat, dust, and dampness, operating smoothly and efficiently for years with only minimum maintenance.

Today, the Tri-Clad family includes many different types and sizes. But whatever your selection, the Tri-Clad motor nameplate is still your best assurance of a high return on your motor dollar. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*



EXTRA PROTECTION . . . AGAINST PHYSICAL DAMAGE!
Rigid cast-iron frame and end shields protect vital motor parts from external abuse. Because they're not at the mercy of a coat of paint, they strongly resist chemical attack and dampness. Cast iron also gives you wide nonyielding metal fits between end shields and frame for ease of assembly.

EXTRA PROTECTION . . . AGAINST ELECTRICAL BREAKDOWN!
Motor windings of Formex* wire, together with improved insulating materials, reduce the chances of electrical failure. Heat is dissipated quickly—motor stays young for years and years!

EXTRA PROTECTION... AGAINST OPERATING WEAR AND TEAR!
Bearing design affords longer life, greater capacity, improved lubrication features. Bearing seals retain lubricant, keep out dirt. One-piece, cast-aluminum rotor is practically indestructible.

*Trade-mark reg. U.S. Pat. Off.

GENERAL ELECTRIC

750-287

TRI-CLAD
REG. U.S. PAT. OFF.
MOTORS

- OPEN (DRIPPROOF)
- TOTALLY ENCLOSED
- EXPLOSION-PROOF

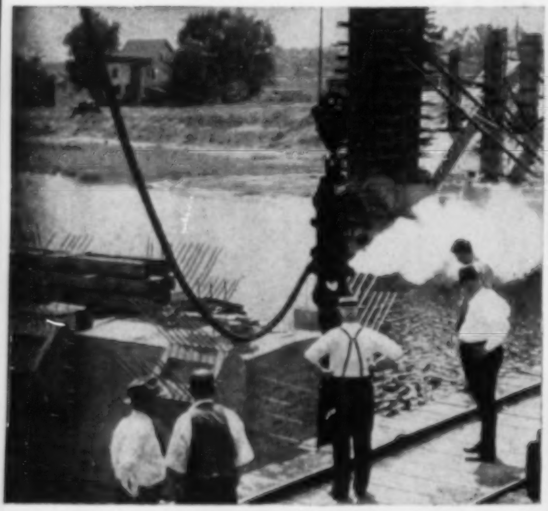
Contractors *prefer*

Manhattan HOSE

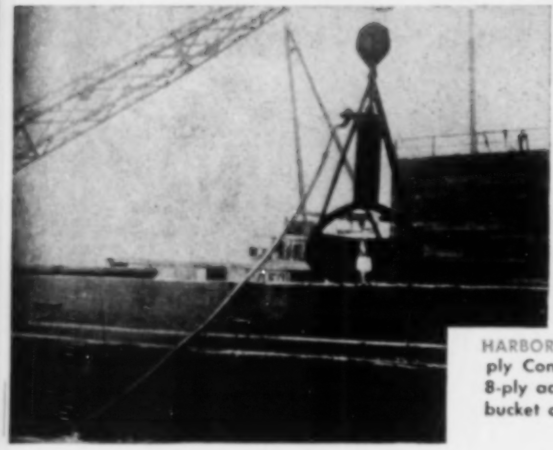
HEAVY DUTY ROAD WORK (Above) requires Condor Duck Plied Water Hose.

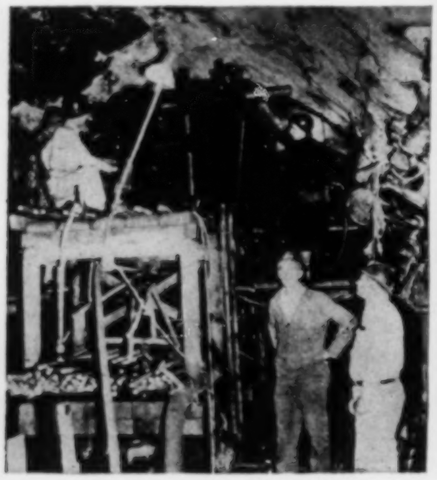
PILE DRIVING (Below) with Condor Pile Driver Hose on a bridge project.

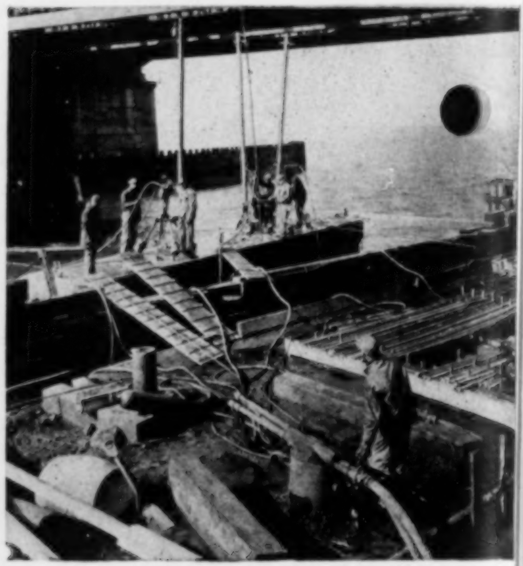
JACKHAMMERS.—Right: Condor Homo-Flex Air Hose, lighter, easier to handle on Jackhammers. Exceptionally resistant to ragged rock punishment.



DAM EXCAVATION—Above: Draining low portion of a dam excavation, 300 G.P.M. against 90′ head. Manhattan Suction Hose stands up on big jobs.







HARBOR WORK—Left: 2" 6-ply Condor Hydraulic Hose, 8-ply activating a clam shell bucket on a dredge.

NANTAHALA TUNNEL—Condor 2" Tunnel Air Hose and Homo-Flex Air Drill and Water Hose used in driving a 5-mile river-diversion tunnel in Nantahala, N.C.

RAILROAD BRIDGE — Above: Drilling 30′ holes in concrete piers of old railroad bridge, job that calls for Condor heavy duck ply air hose on manifold feeds, and lighter, highly flexible Homo-Flex Hose on drills.

On jobs like those pictured here, profit depends on pushing up the schedules. You can't afford hose failures when men and machinery must wait for replacements. Condor hose constructions are engineered for the heavy demands of big projects. Each hose is built for a specific service . . . You can rely on Manhattan's 54 years of engineering experience for hose that keeps you ahead of schedule.

Bulletin 8688 shows many other case history photos of Manhattan hose, conveyor belts, transmission belts and V-belts in action on history-making construction jobs. Your copy will be sent with no obligation.

RAYBESTOS
R M
MANHATTAN

RAYBESTOS-MANHATTAN INC.

Keep Ahead with Manhattan

MANHATTAN RUBBER DIVISION **PASSAIC, NEW JERSEY**

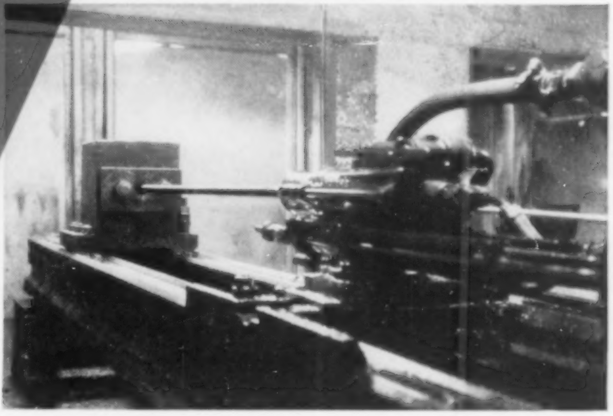
FROM THE RECORD

A Few
Outstanding
CRUSCA JOBS

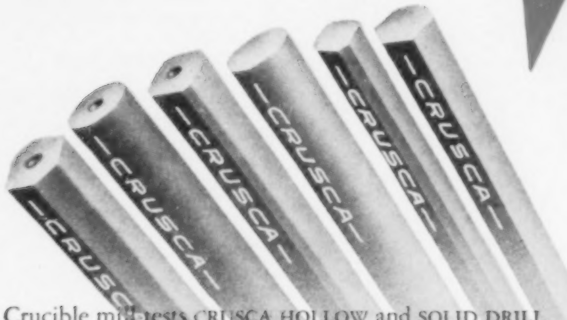
DELAWARE AQUEDUCT
PENNSYLVANIA TURNPIKE
BROOKLYN-BATTERY TUNNEL
CASCADE TUNNEL
BOULDER DAM
T. V. A.
GRAND COULEE

Another reason why CRUCIBLE'S Crusca Drill Steel *is used on leading jobs*

Testing Crucible's CRUSCA drill steel by making hole in hard granite.



Fatigue testing Crucible's CRUSCA drill steel against an alloy steel block.


—CRUSCA—
—CRUSCA—
—CRUSCA—
—CRUSCA—
—CRUSCA—
—CRUSCA—

Three Shapes, All Sizes

Crucible mill-tests CRUSCA HOLLOW and SOLID DRILL STEEL under conditions more severe than are encountered in actual service. One method of testing, the block test, requires that the steel be driven against a hardened alloy steel block at full air pressure and wide open throttle. No steel can take this abuse forever, but Crucible's CRUSCA stands up longer than any other competitive drill steel before failure... else that lot of drill steel is scrapped.

Another test is drilling in hard granite. Crucible's CRUSCA must drill more holes... or *that* lot is scrapped. Every known make and size of drilling equipment is used in these tests of CRUSCA so you can be sure that the CRUCSA you get will drill more holes, regardless of machine or working pressures.

These mill tests and inspections insure the high quality and uniformity of every lot of CRUSCA drill steel. They check hole concentricity and accuracy of section in addition to superior drill properties, resistance to fatigue, stiffness and uniformity of analysis and structure.

On the big jobs for the past 50 years, it's been Crucible's CRUSCA drill steel... the drill steel the blacksmiths like... the drill steel the drillers go for.

You can get CRUSCA drill steel in both carbon and alloy types... in three shapes and in all sizes. There is new "PARK A" alloy drill steel for "JACKSTUD" insertion. If you want to make more holes at less cost, call your Crucible CRUSCA salesman. He can supply you with exactly the CRUSCA drill steel you need.

WRITE FOR THE LATEST CRUSCA CATALOG

CRUCIBLE STEEL Company of America

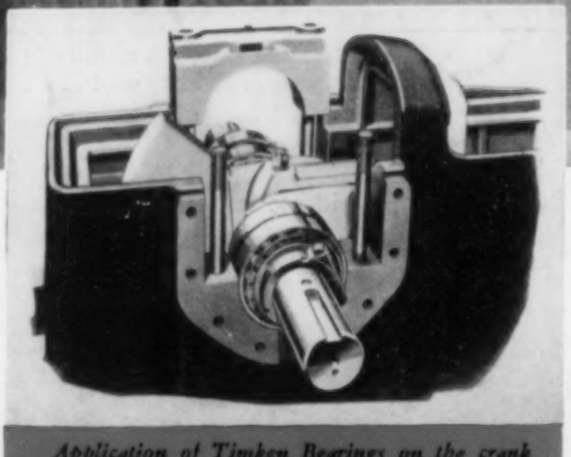
"FULL-RANGE" QUALITY STEELS for INDUSTRY

HIGH SPEED · TOOL · STAINLESS · ALLOY · MACHINERY · SPECIAL PURPOSE STEELS

Chrysler Building, 405 Lexington Ave., N. Y. 17, N. Y. Branches, Warehouses, and Distributors in Principal Cities. Consult your Telephone Directory or Thomas' Register for Nearest Office

SELECT AN ANTI-FRICTIONIZED COMPRESSOR FOR

Maximum Efficiency



Ingersoll-Rand 9 x 9 ES-1 Air Compressor on air lift pumping service.

Application of Timken Bearings on the crank shaft of Ingersoll-Rand ES-1 Air Compressor.

Make sure the crank shaft bearings are Timken Tapered Roller Bearings. Then you will be sure of getting the highest possible standard of anti-friction efficiency.

It isn't just a matter of eliminating friction; that can be taken for granted. It is the ability of Timken Bearings to carry radial loads, thrust loads or both together in any combination; and to hold revolving parts in correct and constant alignment; plus reserve strength and endurance for any emergency. Specify "Timken Bearing Equipped" when buying anti-frictionized compressors of any kind and look for the trade-mark "TIMKEN" on every bearing you use. The Timken Roller Bearing Company, Canton 6, Ohio.

TIMKEN
TRADE-MARK REG. U. S. PAT. OFF.
TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL AND THRUST →←LOADS OR ANY COMBINATION